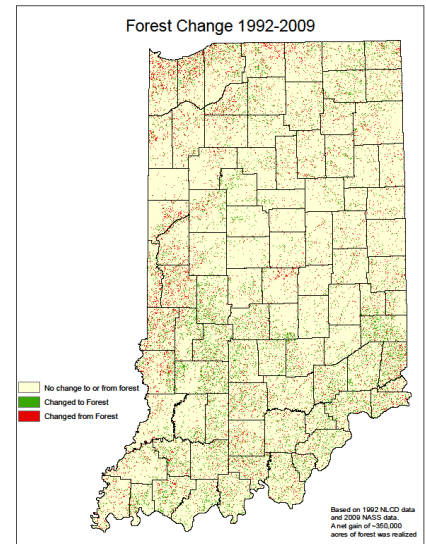
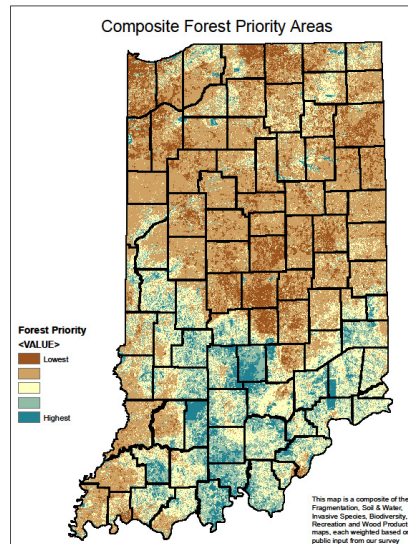
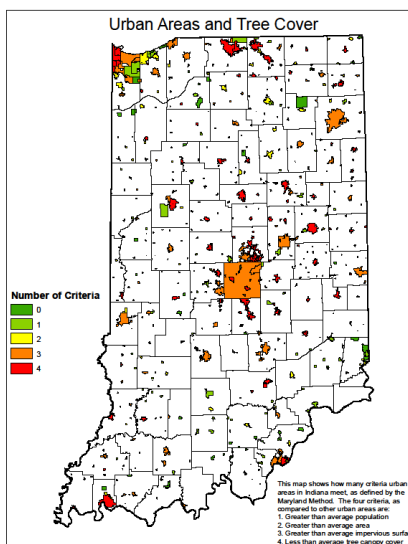
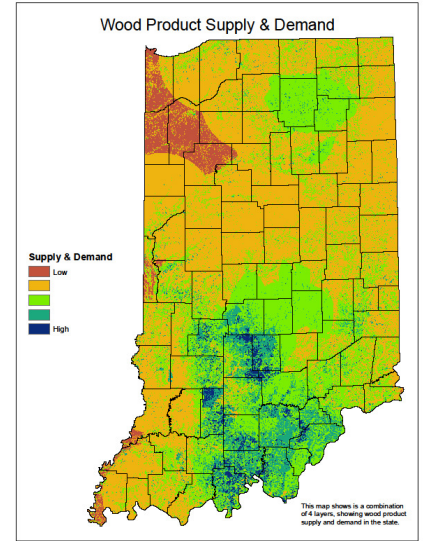
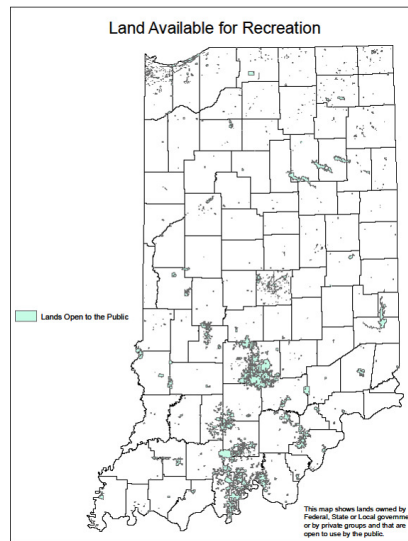
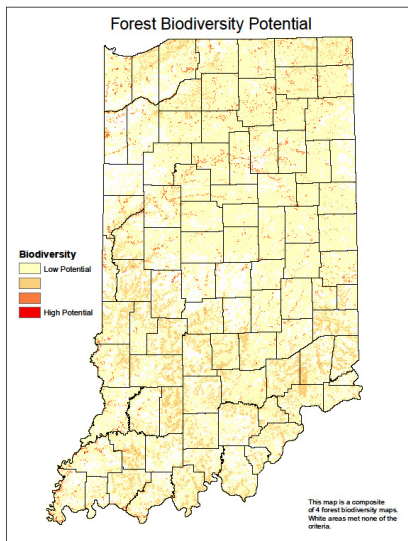
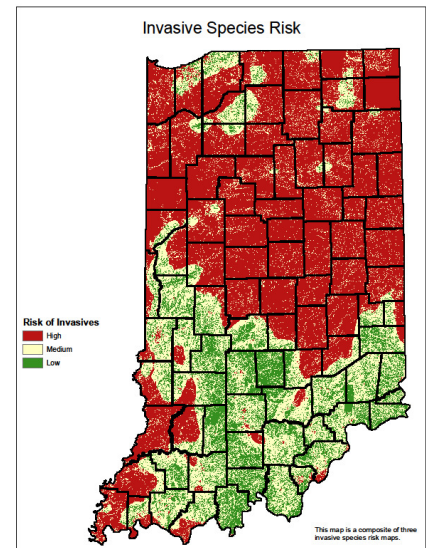
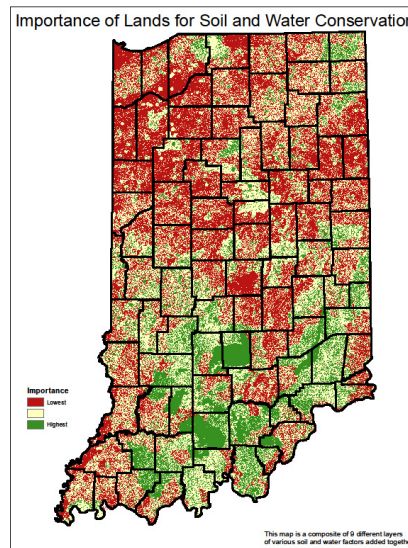
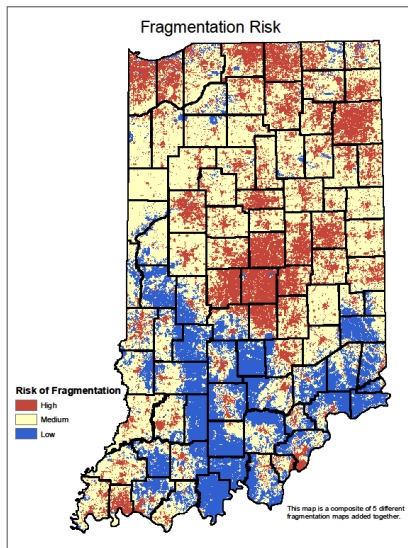


INDIANA STATEWIDE FOREST ASSESSMENT 2010



Indiana Statewide Forest Assessment 2010

Executive Summary

In different ways forests have always sustained societies in Indiana but the relationship between society and forests has not been static and is constantly evolving. The 2010 Statewide Assessment of Forest Resources in Indiana presents a view of society's changing relationship with forests. With an increased demand by a growing human population upon the various benefits forests provide, from timber and lumber to clean air, water and wildlife habitat, there are questions as to the sustainability of the forest resource in the State.

This Assessment is intended to inform those questions but also to highlight important information that is necessary and lacking in order to ensure that these benefits and ecosystems services are recognized, maintained and enhanced into the future. Ultimately, this document should provide some tools that will help to direct a prioritization of efforts in the coming years and in the face of decreasing funds to secure a future forest resource that is reflective of societies needs.

Landscape scale understanding of Indiana's forest issues has required the input of thousands of individual stakeholders and the statewide scope of this document is based on their concerns, values and insightful direction. Stakeholder participation is so valuable because the vast majority of these forests and woodlands, 85% in total, are owned by private individuals and families.

Indiana's unique and high quality forests are a part of the fabric of Midwestern wealth and development. With this document Hoosiers are presented information on the forest issues, threats and benefits that have far ranging impacts on jobs, health, and quality of life, among other things. Answers to the following questions are provided:

- What percent of forests in Indiana are protected and off limits to conversion and development?
- In which watersheds do forests best protect the public drinking water of the citizenry?
- How can we pinpoint the threats associated with exotic invasive species?
- Where in the State are forests likely to have rich biologic diversity?
- What percentage of forestland is open to the public for recreation?
- Which counties have had the most severe loss of forestland since 1992?

Indiana's forests of the future depend on how the answers to these questions are used to effectuate plans and implement changes that positively impact society's changing relationship with forests.

Note to Reviewers:

Dear Partner in Landscape Conservation and Stewardship,

Thank you for your interest in reviewing the first geospatial assessment of Indiana's forest resources. The document is 73 pages long but you will find that because there are a great many maps it will not take you that long to read.

Reviewers are requested to provide (in detail) alternative perspectives to make sure topics are covered thoroughly. Please remember that the Assessment strives to be as objective as possible. Opinions on the most important issues and ideas on how to address issues identified in the Assessment will be used in the next step of the planning process – the Statewide Strategy.

Because this is the first time an Assessment has been conducted with a geospatial focus, it is appropriate to consider this a pilot project that upon completion will be reviewed and assessed for its effectiveness. Comments on the format, process, and efficacy are encouraged.

In particular, the authors wish to draw attention to the Priority Landscape Areas analysis. This analysis makes weighting assumptions based on a large and diverse but non-scientific survey and relies on a limited number of data sets to represent issues facing Indiana's forests. Nonetheless, the authors believe that this analysis represents the best available information to satisfy required elements of the Assessment. It will be helpful to note where there are specific areas in Indiana, or multi-state areas that should be prioritized but were not captured in the GIS overlay analysis methodology.



Finally, the authors would like to again thank you for your input on this document and to again remind reviewers: 1.) This is a GIS based assessment. 2.) The scope is statewide. 3.) This is not a strategy. 4.) State of Indiana is severely limited financially. Please be cognizant of these items as you make suggestions, comments and recommend improvements.

We appreciate your participation in the Statewide Forest Assessment and Strategy Process.

<http://www.in.gov/dnr/forestry/5436.htm>

Sincerely,

Division of Forestry, Statewide Assessment Steering Committee



Indiana Statewide Forest Assessment 2010

Table of Contents

	Page
Introduction	
Goals and Objectives	1
Document Design	2
Acknowledgements	3
Forest Conditions, Trends, Threats and Priority Landscape Areas by Issue	
Fragmentation	7
Soil & Water	15
Invasives	26
Biodiversity	32
Recreation	39
Industry	40
Other Issues	46
Priority Landscape Areas	
Indiana – composite map	50
Multi-state	51
Coordination with Groups and Other Plans	
Stakeholder Involvement	52
Document Review Process	53
Appendices	
A: Priority Landscape Areas Methodology	54
B: List of Data Gaps	56
C: References	57
D: Glossary & Index (with links to external information)	58
E: How the Assessment Addresses the National Themes	60
F: Contributing stakeholder groups	61
G: Additional maps	67

Introduction

The Indiana Statewide Forest Assessment 2010 (“Assessment”) is the first geospatially based assessment of all private, public, urban and rural forest resources in the State.

The last comprehensive assessment of Indiana’s statewide forest resources was produced in August, 1981. Before that time and since, Indiana’s forests have continued in their constant process of change and evolution. Adding a layer of complexity, forests are also interacting with society in new and different ways.

New technologies have been developed that improve our understanding of complex forest ecosystem interactions, the efficiency with which we harvest, create and market products derived from forests and how we communicate, learn and disseminate information about this valuable resource. But perennial conflict remains around balancing a resource base with an increasing user population. And society has created new issues and new roles for forests as providers of biomass for electricity generation, feed stock for cellulosic ethanol and storehouses of carbon to mitigate changes in the atmosphere.

As with many others areas of society, sustainability has become a buzz word for forestry and natural resources. This is a word that means many things to many people. This assessment attempts to address the sustainability of Indiana’s forest resources and defines sustainable forests as those that can continue to provide broad and diverse benefits, among them ecosystem services and timber production, for generations to come.

Before using the Assessment please read through following sections: goals and objectives, document design and acknowledgements. These sections provide an understanding of the framework, purpose, scope and perspective of the document and will be useful to place the information within a context accounting for the intent of the authors.

Goals and Objectives

The Assessment attempts to show the “state of affairs” of Indiana’s private and public forests and analyze the sustainability of forested ecosystems on a statewide or landscape level.

This assessment will be used by (1) Indiana Department of Natural Resources (“IDNR”) staff to conduct management and design policy, (2) external partners and stakeholders involved in landscape conservation and stewardship who require statewide data, and (3) as a requirement of the United States Forest Service (“USFS”), State & Private Forestry Program (“S&PF”). The information is also intended to be concise while remaining accessible and understandable to the general public.

The Assessment strives to present unbiased findings and conclusions to provide a valuable source of information for others. It should also form a basis for its companion document, the Statewide Forest Resource Strategy.

The Food, Conservation, and Energy Act of 2008, commonly referred to as the Farm Bill, was enacted on June 19, 2008. The legislation amended the Cooperative Forestry Assistance Act of 1978 (CFAA) and requires each state to complete a Statewide Forest Resource Assessment, followed by the development of a Statewide Forest Resource Strategy to receive, or continue to receive, funds under CFAA.

CFAA funds are provided to states through the State and Private Forestry (S&PF) organization of the USDA Forest Service. Currently, Indiana receives these funds annually to assist private forest landowners, promote healthy forest practices, assist communities with their urban forests and protect communities from wildfire. A large portion of the CFAA funding received by the Indiana Division of Forestry is passed to local organizations by way of grants that provide matching funds and additional implementation resources.

Document Design

The statewide scope of this document reflects the distribution of benefits and services that are produced by all forests. Forest benefits and services, like clean water, forest products, and wildlife habitat are produced by all forests, statewide. Risks to forests, like fire, insects and disease or development can occur anywhere and often spread across large areas affecting public and privately owned forests. The scope of this document is statewide and it is geared toward informing landscape level decisions. A risk of using statewide data is that at times, a critical issue or threat in one region of the state may be masked by a stable condition statewide. When this became evident in the analysis, the authors assessed the regional threat and determined if it was great enough to highlight and evaluate. When available and valuable to do so, data is presented at other levels, e.g. county, or to show an example data set that would be informative if it becomes available statewide in the future.

Because this is a geospatially based assessment certain important issues are underrepresented due to a lack of transferability into geographic imaging systems. Because of their diffuse or intangible nature, issues like education, will always be more difficult to represent using maps but it is expected that methods will develop that allow for fuller representation in the future and it is anticipated that data layers will also shift in importance or potentially become inapplicable.

Indiana forest resource conditions, trends, threats and priority areas are presented according to the State's recognized forest issues and their relative importance. It is believed that by using this framework we are encouraging utilization and application of data at multiple levels and fostering cooperation and common understanding in the State.

The relative importance of issues and their respective levels of concern were expressed by Hoosier landowners, resource professionals and other stakeholders in a June 2009 survey. Significant focus is placed upon the issues of recognized importance but an effort is made to also consider items that are important but have perhaps not registered across this larger societal spectrum. These items are directly related to USFS National Themes in Appendix E.

<u>Indiana Forest Issue</u>	<u>Relative Importance Score</u>
Fragmentation and/or conversion of forests to another land use	507
Conservation and maintenance of soil and water resources	425
The spread and control of invasive species	421
Conservation of biodiversity	364
Counterproductive government forest conservation related policies	249
Availability of land for public recreation	234
High cost of forest ownership and low incentives to retain	226
Conservation of forests that protect drinking water supplies	206
Overpopulation of white-tailed deer	194
Inadequate public education about forests	166
Sustaining Indiana's forest product industry	160
Lack of active management on forests	146
Sustainable regeneration of oak woodlands	138

Inadequate youth education about forests	94
Lack of healthy woodlands and trees in urban areas	90
The control of forest fires	73
The loss of fire dependent plant communities and habitats	67
Forests not managed for carbon storage	45

Today forested landscapes cover around 5 million acres or 21% of Indiana’s land base. All of these forests are important for providing associated benefits and services but certain areas are prioritized as part of the overall Assessment requirements. This is determined through a geospatial layering analysis (See Appendix A for associated methodology) that identifies priority landscape areas with the purpose, as described in S&PF national guidance: “to ensure that federal and state resources are being focused on important landscape areas with the greatest opportunity to address shared management priorities and achieve measurable outcomes.” Priority Landscape Areas represent the issues of greatest importance and need. There is also description of multi-state areas that are a regional priority.

The authors decided to present data from different time periods in order to capture the most reliable data for the particular issue. The reader should not infer that data presented with different dates is particularly relevant to the analysis.

This Assessment is designed to initiate an iterative process that will occur every 5 years. Because this is the first geospatially based Assessment to address the sustainability of all forests in Indiana many data sources are inadequate. Where the authors have considered these "data gaps" important they are noted in the text and also listed and expanded upon in Appendix B. It is expected that these data gaps will be a focus in Statewide Forest Resource Strategy development.

The Appendices include links, references and source information for topics that were beyond the Assessment’s scope or already covered comprehensively and expertly through other efforts.

Except where specifically noted, this Assessment is not intended to duplicate or replace statewide plans that currently exist on topics addressed herein. Rather, the intent of the Assessment is to build upon, coalesce and present new information. Effort has been made not to directly present information from existing Statewide Assessments, i.e. USFS Forest Inventory Analysis reports, State Comprehensive Outdoor Recreation Plan and Wildlife Action Plan. Many of these plans do not have a geospatial focus. The specific list of statewide plans and other documents that were reviewed and incorporated in this Assessment can be found in Appendix G.

A further detailing of efforts to develop this Assessment, coordinate with stakeholder groups and individuals and encourage the widest possible participation makes up the final section of the assessment and includes the names of authors, reviewers and contributors to this effort.

Acknowledgements

The DNR, Division of Forestry is the primary author in consultation with natural resource professionals across Indiana. The authors have made every effort to not solely present data from the perspective of the DNR. Data sources are from a wide variety of agencies and organizations.

The Assessment has been most influenced by stakeholder input, guidance and participation. Please see the Stakeholder Involvement section under Coordination with Groups and Other Plans and also Appendix G: Contributing stakeholder groups, list of reviewers. The authors would specifically like to thank the following persons for their contributions and input: Steve Backs, Bill Bull, John Castrale,

Drew Daily, Ben Eddy, Tom Evans, Joey Gallion, Scott Haulton, Carl Hauser, Brenda Huter, Ellen Jacquart, Pam Louks, Phil Marshall, Duane McCoy, Marcus Mitch, Dev Niyogi, Katie Smith, Zach Smith, Mike Seidl, Jeff Settle, Chad Stewart, Sean Sweeney, Rob Swihart and Chris Woodall.

Special recognition goes to Brett Martin with the Division of Forestry who created all the maps that are featured in this Assessment.

Forest Conditions, Trends, Threats and Priority Landscape Areas by Issue

Indiana's unique and high quality forests are a part of the fabric of Midwestern wealth and development. The issues that are paramount in determining the sustainability of forest resources have far ranging impacts on Hoosier jobs, health, and quality of life, among other things.

Landscape conservation and stewardship requires information and resources to facilitate the many shared goals of organizations and partners in the field. The following analysis should inform decision making related to forestry and land-use and it is presented such that specific issues, like water quality, economic development or public recreation can be considered separately and given a local priority weighting that may differ from any statewide priorities discussed herein. Partners are encouraged to analyze issue components independently where certain factors may be less relevant at more local scales or where initiatives have a more narrowly defined focus. Also, this section should have applications to the Indiana relevant sections of broader scale regional work that extends beyond the State's borders. Existing and potential multi-state priorities are discussed briefly in the following section.

Considered together, Indiana's forest issues represent an informed Hoosier perspective on forest threats, benefits and conservation priorities that are reflective of trends in the State. Forest benefits, like recreation and biodiversity are recognized and evaluated in juxtaposition with threats to forests, like wildfire and conversion. Indiana forest issues comprise the framework for the major analysis of the Assessment and are developed consistently with the priorities of Indiana forest stakeholders and interested parties. Using Indiana's forest issues in this way, to prioritize forest importance, offers an analytical opportunity that mirrors the complexity and tradeoffs involved all economic decision making.

Over the past two hundred years Indiana's forests have shown remarkable resilience and present a case study in resource sustainability. The lessons that were learned by society after the cutover that followed the European settling of this State and the response guided by eminent Hoosier conservationists, like Richard Lieber and Charles Deam among others, are lessons that have application today as society responds to new forest threats and issues.

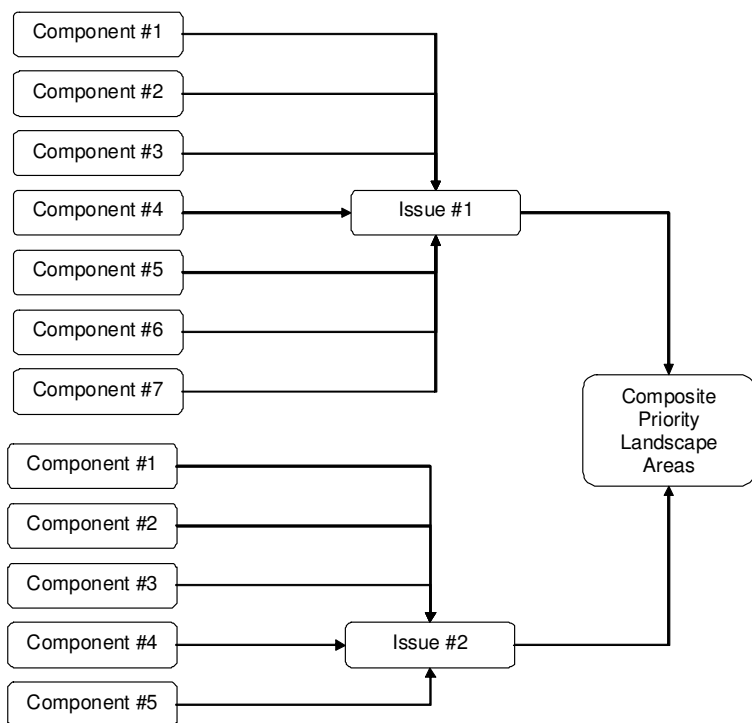
[Insert photographs of R. Lieber, C. Deam]

American ecologist Aldo Leopold, states that conservation is a state of harmony between men and land. Such being the case, bringing harmony to society's relationship with forests has become exponentially more complicated as private individuals, who own 85% Indiana's forests, have become more numerous and divided ownerships into smaller and smaller tracts.

Indiana's forests will never be the forests that existed at the time of European settlement. Major forest ecosystem components, like the passenger pigeon, have been removed forever and can not be replaced. Similarly, land management practices of the past, like the free ranging of millions of hogs or widespread burning of large areas, that were formative for Indiana's forests can not be practiced on a similar scale today. Forest stewards and conservationists are key partners to assist society in understanding these formative aspects and helping to shape the landscape scale management that is requisite to sustain and enhance the benefits that our forests currently provide.

In June 2009, approximately 1,400 natural resource professionals, academics, industry and private landowners participated in a survey to determine the relative importance and level of concern around issues facing Indiana's forests. The results of this survey define the content in this section and are used in the priority landscape areas analysis to assign weighting to Geographic Information System ("GIS") maps that attempt to spatially represent these issues. Detailed information about the June 2009 Survey, including the full results, summaries and analysis can be found: <http://www.in.gov/dnr/forestry/5436.htm>

In general, Indiana forest issues presented in this analysis are represented by compiling multiple maps or data layers together to comprise an "issue map." For example, the conservation and maintenance of soil and water resources or "Soil & Water" issue map is comprised of 9 data layers, each adding to our understanding of this complex forest issue. For purposes of discussion, in this analysis these data layers are called "component" maps. Component and issue maps are framed with explanatory material and brief textual context. The focus of this section is the spatially explicit prioritization of lands according to the values that underlie particular forest issues. There are links in the index section of the appendix that serve as a guide to more in depth discussion of the issues themselves. Comprehensive analysis of all the important issues facing Indiana's forests is beyond the scope of this document.



Priority landscape areas for each of the most important Indiana forest issues are defined in this section. These will be used by Indiana Department of Natural Resource professionals and partners to facilitate landscape level conservation and stewardship in Indiana. A composite statewide Priority Landscape Areas map (as well as multi-state areas) is discussed in the following section. This composite map fulfills a Federal Farm Bill requirement but is less applicable to focused initiatives. Schematically represented, **Component** maps feed into **Issue** maps which are then weighted to comprise a **Composite** Priority Landscape Areas map.

This simplistic diagram (above) is meant to convey the relationships between Component, Issue and Composite Priority Landscape Area maps. There are six issues covered in the Priority Landscape Areas analysis. Each Issue map will not have an equal number of Component maps. Component maps contribute equally in weight to create an Issue map. The methodology and data sets for this analysis are more fully described in Appendix A.

Fragmentation

Fragmentation and/or conversion of forests to another land use is the most important threat to the sustainability of Indiana's forests.

The broadly designated issue, hereafter referred to more simply as "fragmentation," can incorporate many different effects on forests. The effects of fragmentation from logging can be relatively short term and present certain ecological differentiation whereas conversion of forestland to impervious surface presents wholly different and significantly more severe ecological effects. Likewise, the effects of a contiguous forest patch being converted to low density residential housing are different from those where conversion is to commodity agricultural production.

The long term sustainability of forested ecosystems is in no small way affected by the ability of these systems to provide genetic response to stress, disease or disasters. Forest systems are complex and genetic transfer is influenced by a multitude of interacting forces from climate changes to fluctuations in wildlife population. Fragmentation inhibits this transfer and weakens the overall systems' ability to adapt and respond to environmental change.

This section considers these ecological aspects of fragmentation as well as those aspects that are driven by economic influences. It considers the growth in human population density and urban areas as well as associated leading indicators, namely roads and existing metropolitan areas. Just as extensive fragmentation can impair the ability of migratory birds to find suitable nesting sites; it can also impair the ability of woodland owners to market timber.

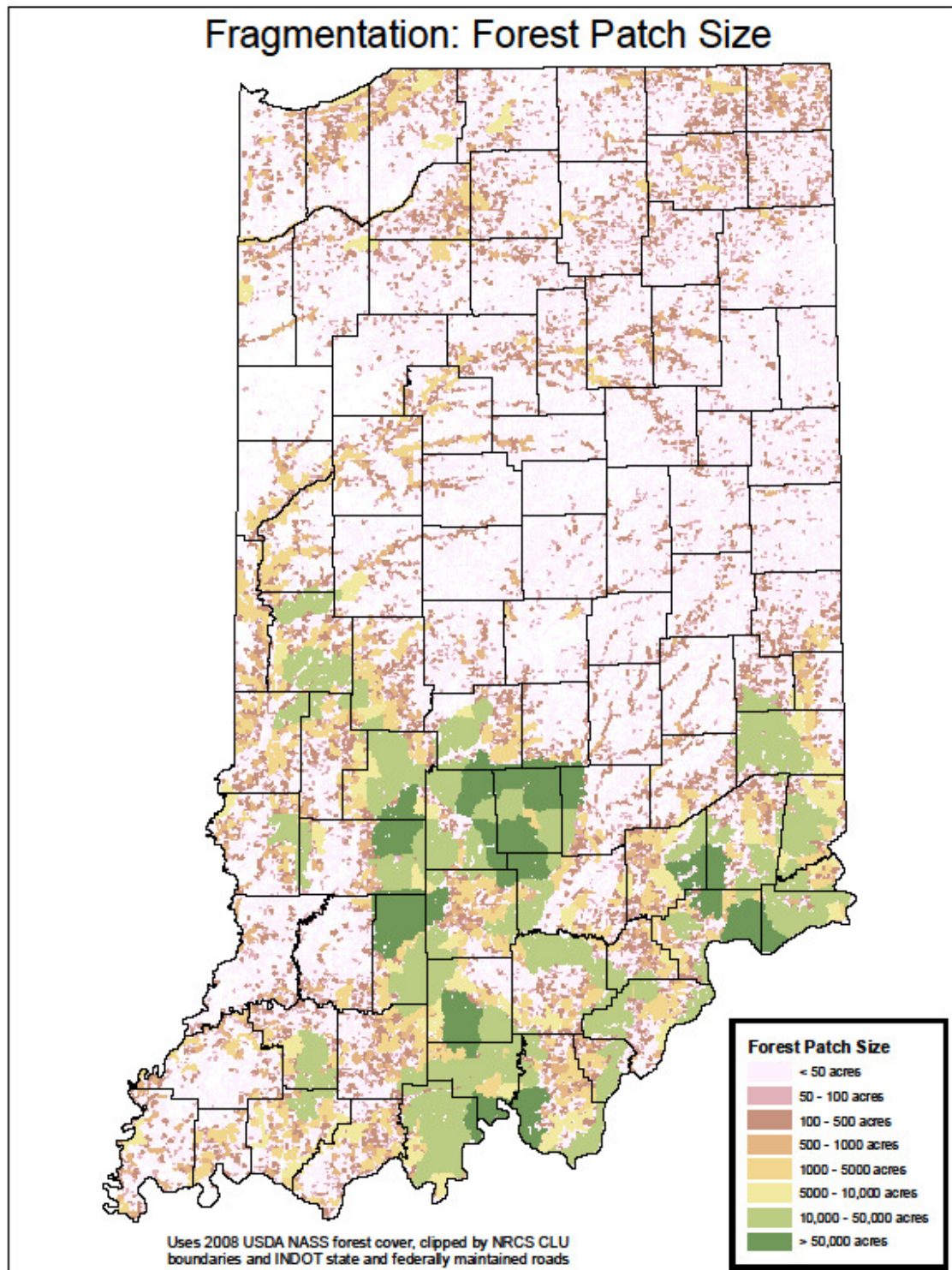
Ownerships (specifically parcel divisions), tax assessment categories and zoning categories will all have some effect on the fragmentation of forests and these are not reflected in this analysis. It is hoped that in the future these data will be available to add further insight into understanding this issue. These items are listed as identified Data Gaps in Appendix B. Further information about the forest issue Fragmentation can be found in Appendix D.

This issue has four equally weighted component maps.

Contiguous Forest Patches

This map depicts contiguous forests, those not divided by state or federal highway, by patch size. Southern Indiana contains the majority of the largest forest patches. There are no forest patches larger than 10,000 acres in Northern Indiana. There are 8 forest patches in Southern Indiana that are larger than 50,000 acres.

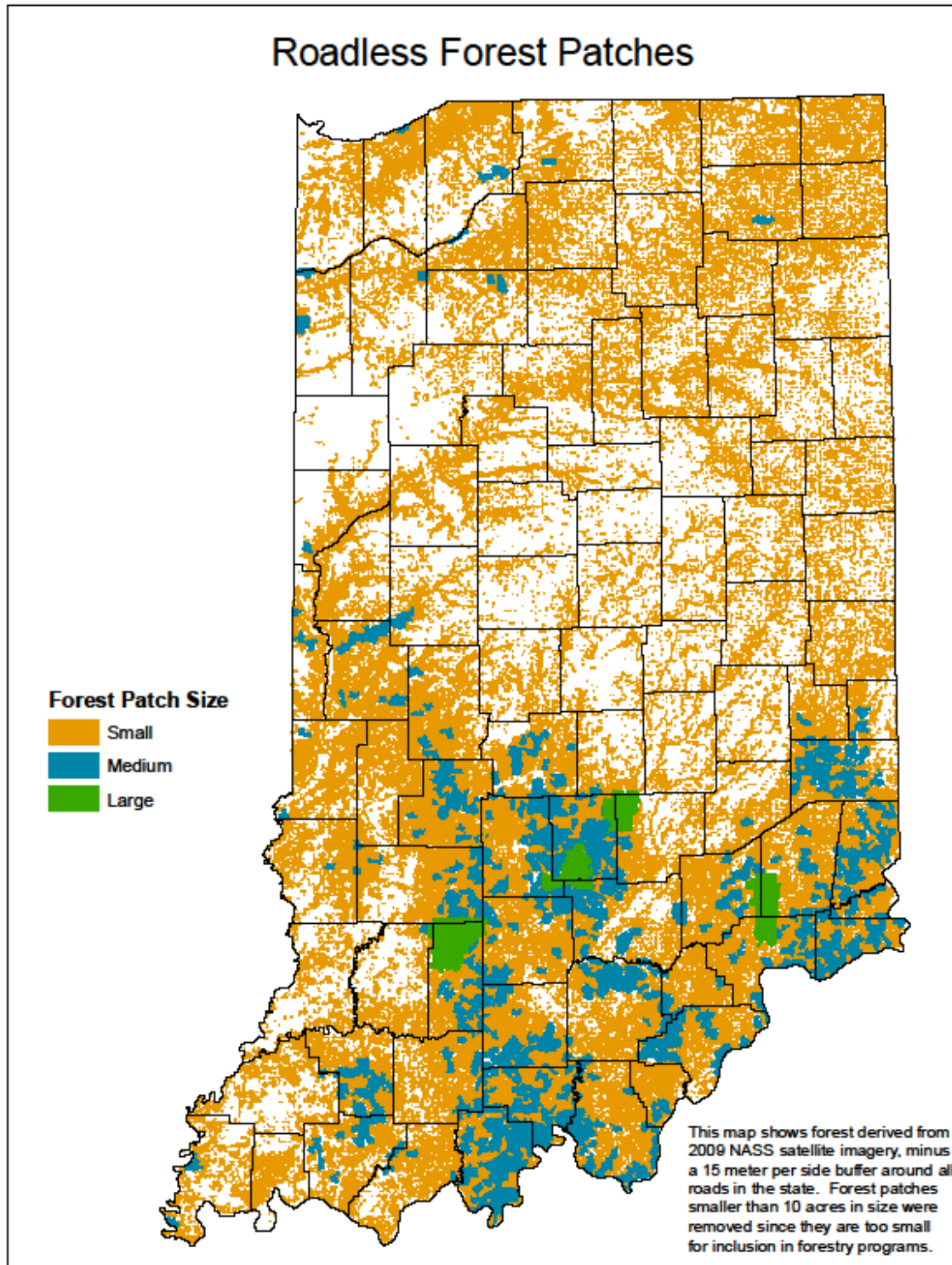
These largest forest patches are those most able to provide forest genetic exchange requisite for healthy ecosystem functions.



Roadless tracts

This map shows forest tracts that are not divided by federal, state, county or local roads. Fragmentation for home building or other development is generally reliant on connection to local and non-local transportation networks.

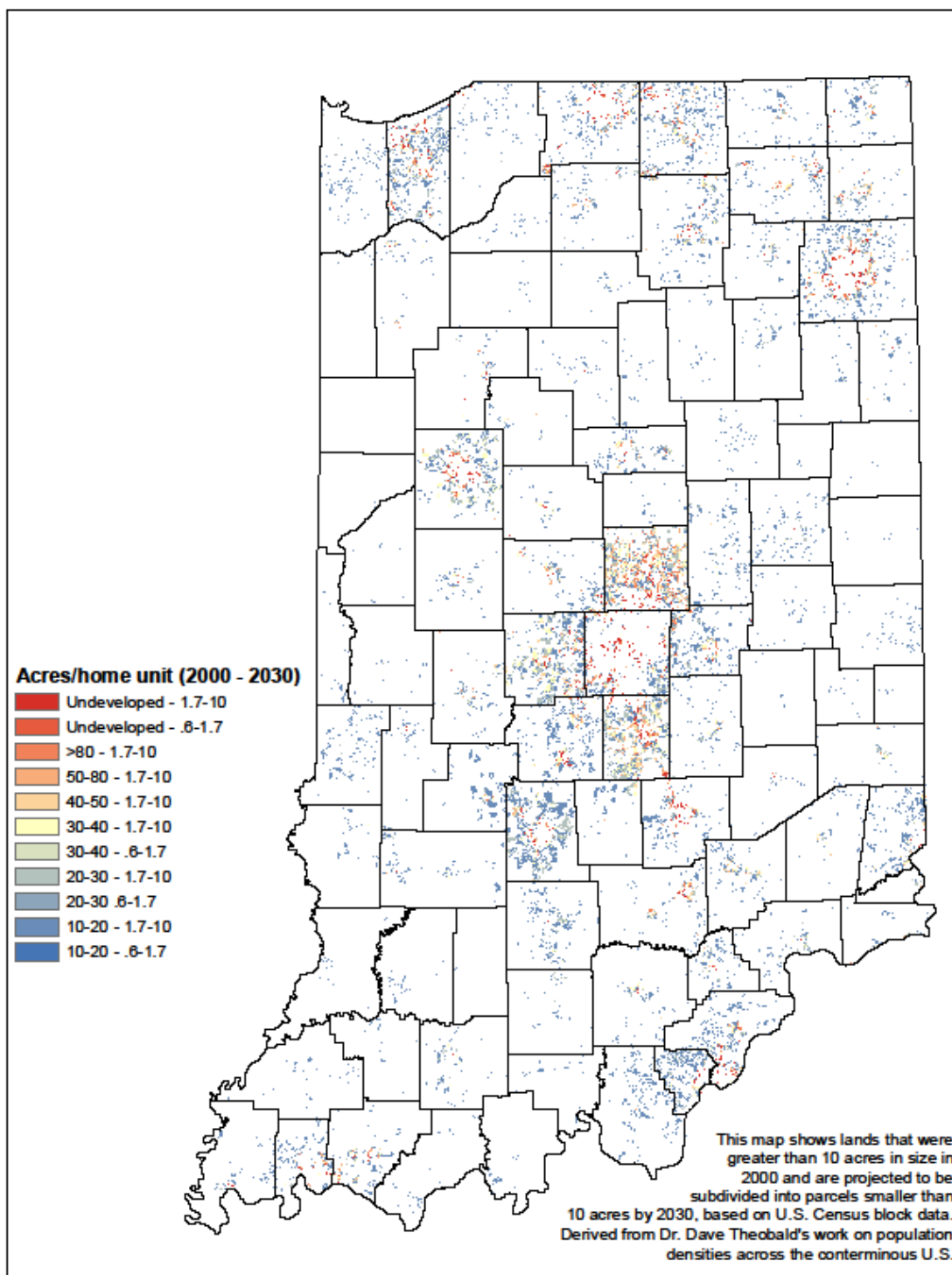
This map may also have applications for forest wildlife and plant species to which roads present major barriers for successful dispersal.



Projected Development Patterns to 2030

The ecological effects of human population density on forested areas can be magnified when development is dispersed rather than concentrated in certain areas.

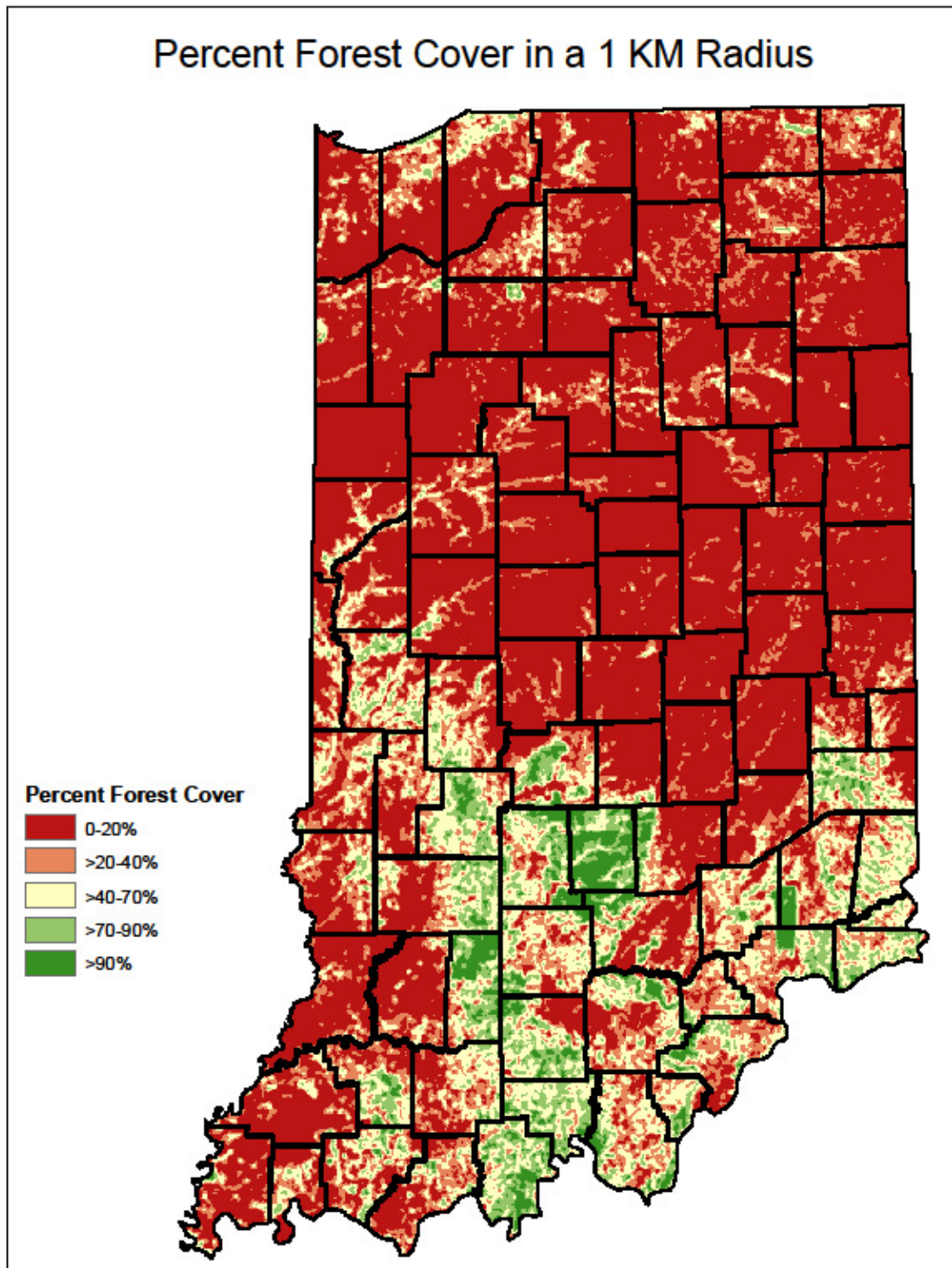
This map projects development patterns with respect to increasing density of home units per acre and is based on a national analysis by Dr. Dave Theobald with the Colorado State University. The map does not reflect recent efforts by some communities to guide development with Smart-Planning or Green Infrastructure Plans. [Insert title on map]



Percent Forest Cover in a 1KM Radius

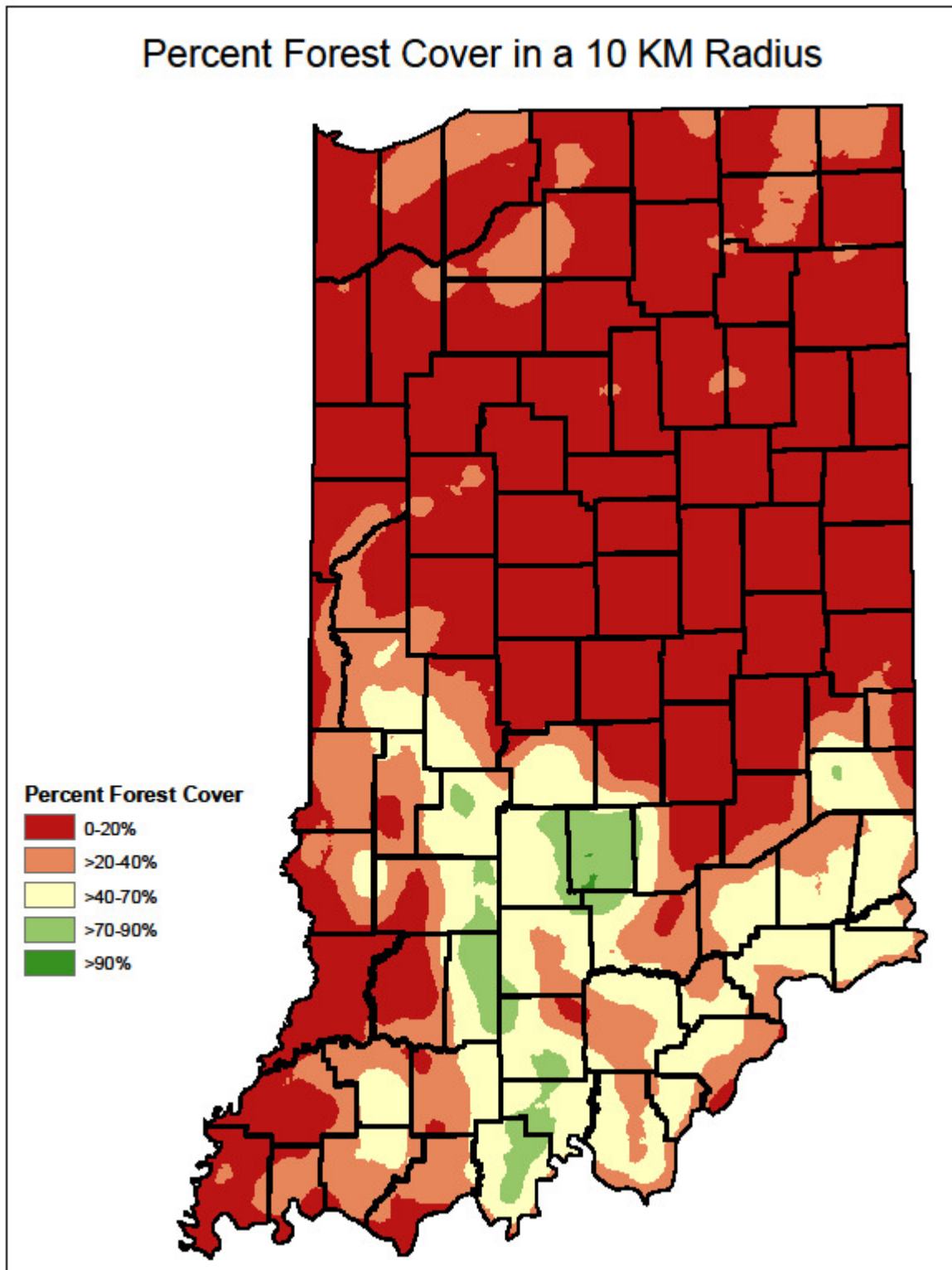
Irrespective of ownerships, this map considers the percentage of forest cover from any point in the State of Indiana. Like the forest patches component map above, this map shows those forests in the State that are best able to respond to environmental stress and perform forest ecosystem functions taking into account the surrounding landscapes.

Also, the proportion of forest cover across a landscape in large part determines the distribution of wildlife, including forest amphibians, bats, and birds.



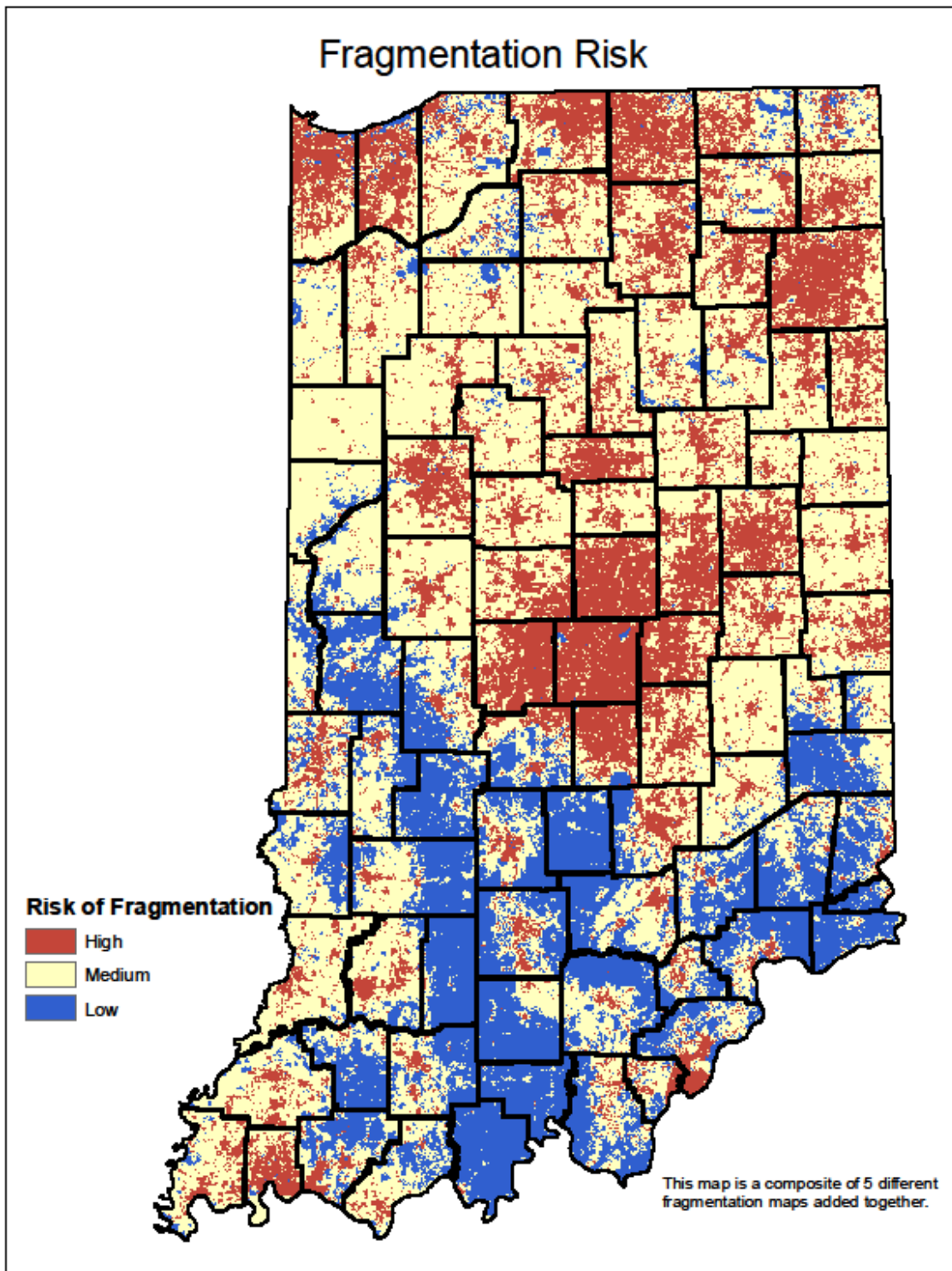
Percent Forest Cover in a 10KM Radius

Expanding on the concept above, this map focuses on the relationship of forest bird populations to fragmentation which has been shown to increase the prevalence of nest loss in the Midwest. Research shows that areas that have very low forest cover (e.g., <15%) had high nest loss at forest edges and within interiors; at moderate levels nest loss was high at edges but not interiors; and in unfragmented areas (>90% forest cover) nest loss was low at both edges and within interiors. (Donovan et al. 1997, Hartley and Hunter 1998, Thompson et al. 2002)



Priority Landscape Areas: Fragmentation

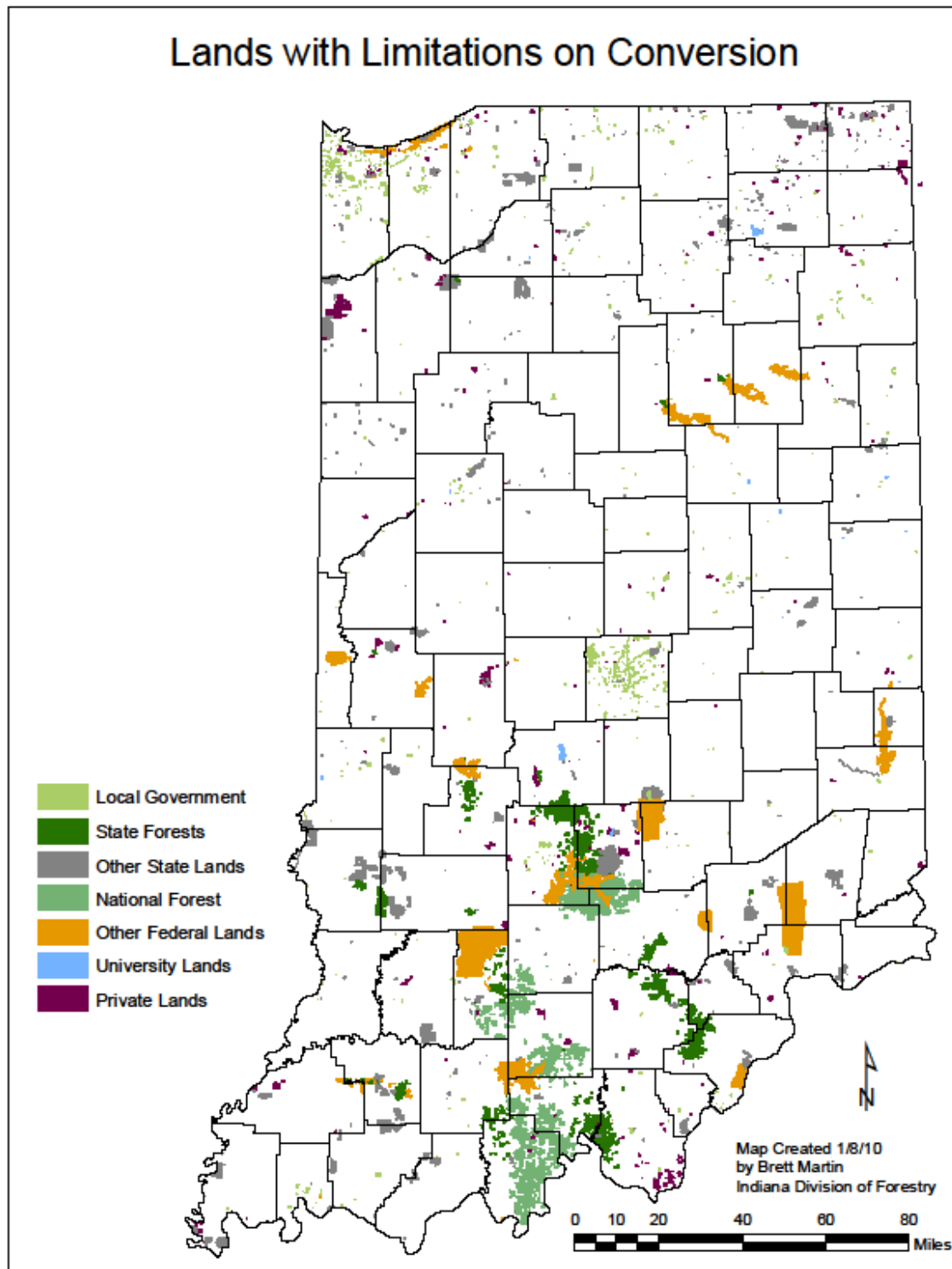
This map should be used for strategy purposes to direct efforts that combat forest fragmentation. It should be noted that strategies will differ in this respect. Areas at high risk for forest fragmentation often carry a higher economic cost, encompass a greater number of ownerships and carry greater inherent ecological denigration. Areas at low risk for forest fragmentation generally contain more intact forest habitats and a greater ability to effectuate landscape scale stewardship and conservation efforts at a lower cost. Thus, conservation efforts to protect against fragmentation should generally be directed to the areas in blue on the map below.



Supplemental map: Lands with Legal Limits to Conversion

This map was not included in any Priority Landscape Areas analysis. It represents lands that are more effectively protected against conversion to another land use in that they have legal restrictions, such as protective easements, or exist in public ownership. The easements reflected in the map are those registered with the Department of Natural Resources, The Nature Conservancy in Indiana and Sycamore Land Trust.

These lands comprise 16.1% of the 5.1 million acres of forestland in Indiana.



Soil & Water

Conservation and maintenance of soil and water resources and the conservation of forests that protect drinking water supplies (“soil & water”) are issues that are very important to Indiana forest stakeholders. Only 7 of the 1,292 respondents to the June 2009 Survey were “not concerned” about these issues and depending on how their importance measures are tallied they are arguably of equal or greater importance than fragmentation (See Introduction page 4).

Undisturbed forests are unsurpassed in their ability to preserve and enhance soil resources and water quality. Forest cover, especially around creek and river bottoms and along drainages or riparian areas, acts as a buffer inhibiting excessive impairment from surrounding exposed soil or agricultural applications.

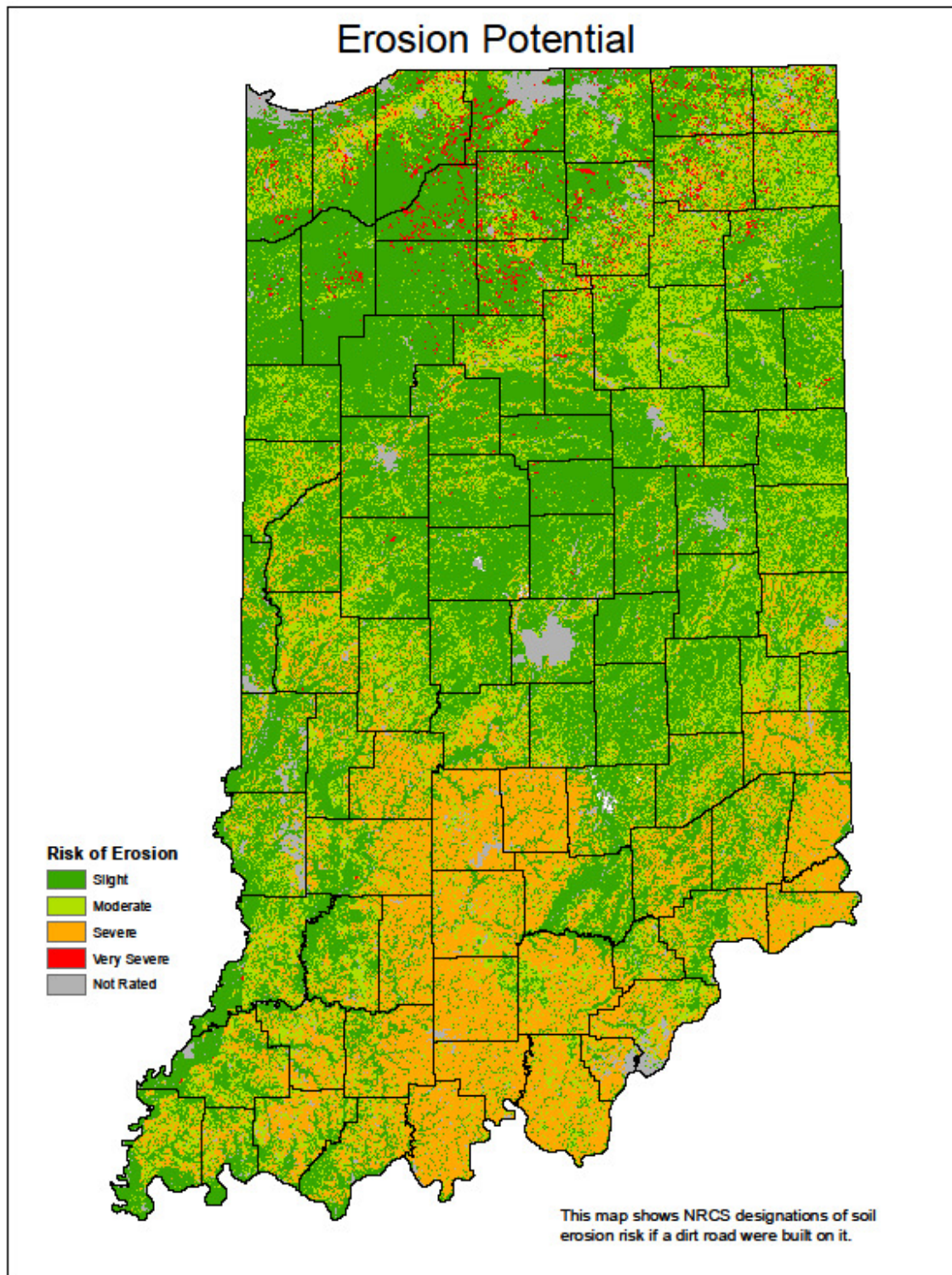
Forest cover alone can not insure water quality in larger watersheds. Inadequately managed point source pollution, roadway and impervious surface runoff, sewage overflows, manure, pesticide and herbicide applications, among other things, can all have effect on the impairment of stream miles across the watersheds discussed.

Best management practices (“BMPs”) that protect soil and water quality during timber harvest, are required on approximately 26% of forestland managed in the State and practiced on managed lands by responsible stewards to insure resource quality and availability in the future. Further information about the forest issue Soil & Water can be found in Appendix D.

This issue has nine equally weighted component maps.

Soil erodibility

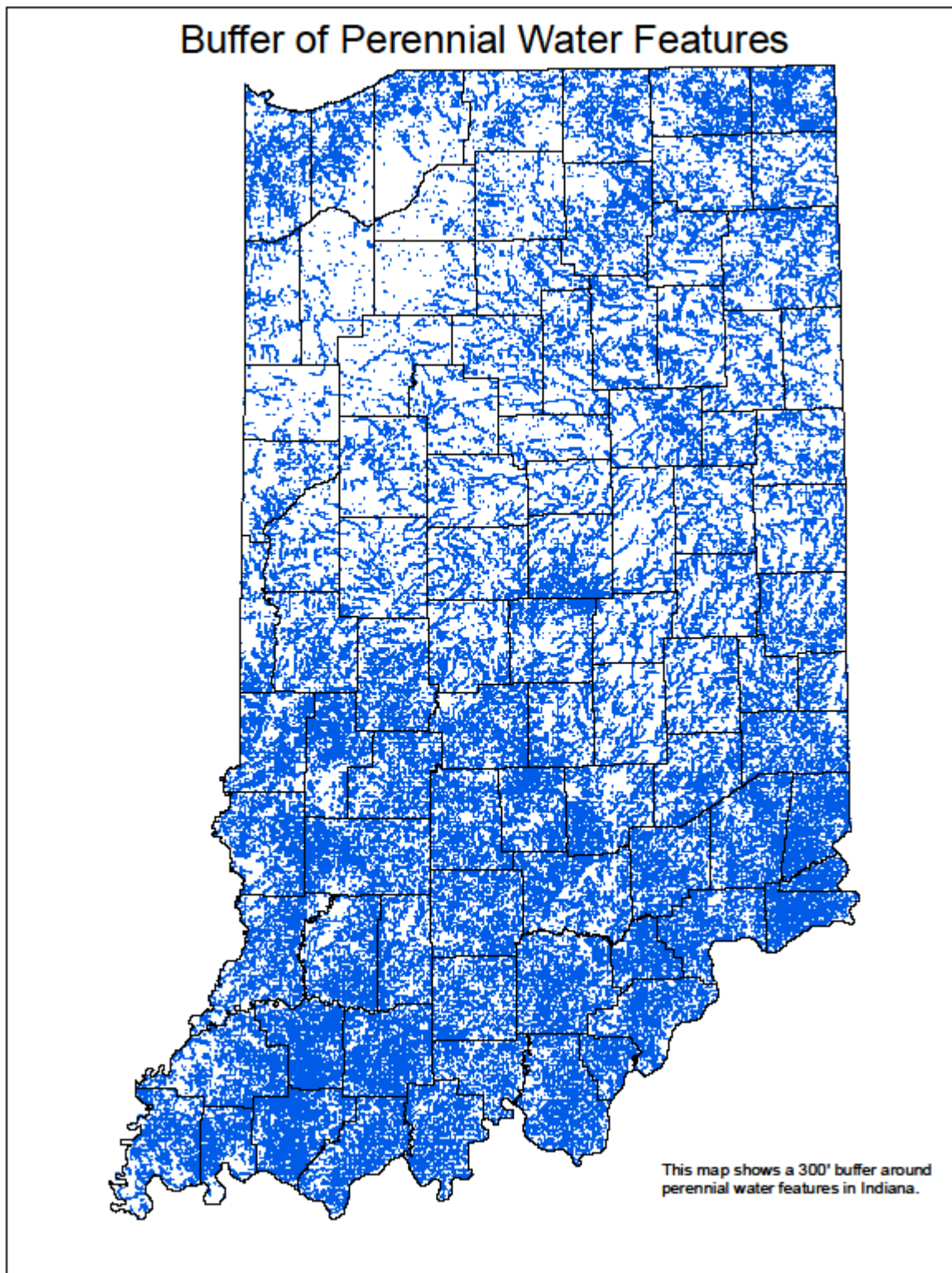
Natural Resource Conservation Service ("NRCS") erosion hazard ratings incorporate erodibility, slope and length of slope and are used to assess risk for putting a dirt road or trail on forestland. This measure can inform forestry practices that include constructing log landings and laying out skid or fire trails. Areas that exhibit in grey are developed areas that are largely impervious surface or water.



[Would this topic benefit from the inclusion of an additional map that highlighted a county or zoomed in on an area to better exhibit data? What county/areas?]

Riparian corridors

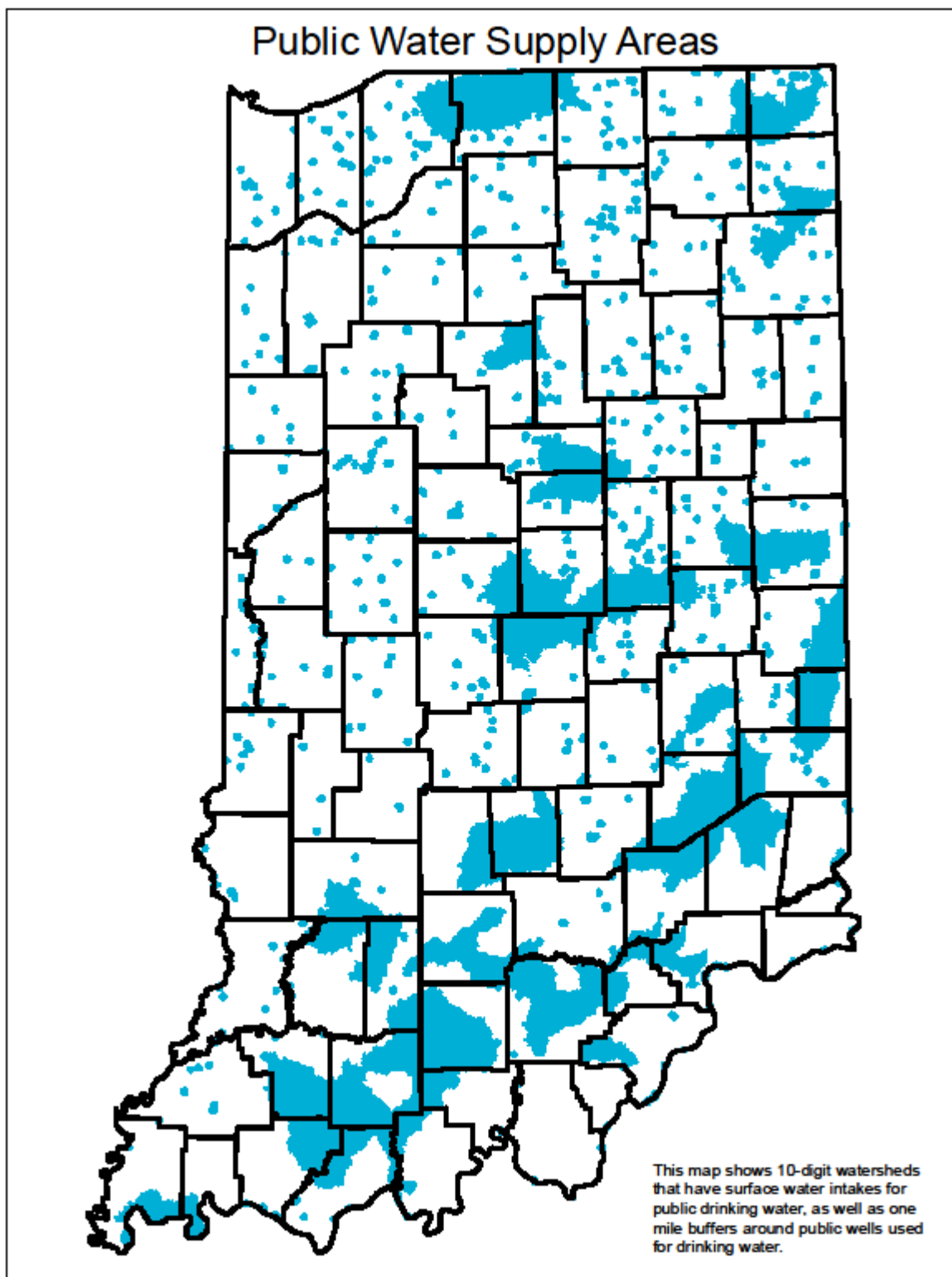
Perennial water features are distinguished from intermittent streams by having water flow year round. Across the State, areas in blue will have the most potential to affect local and downstream water quality. Maintaining a forested buffer around perennial watercourses improves water quality, wildlife habitat and protects soil resources.



[Would this topic benefit from the inclusion of an additional map that highlighted a county or zoomed in on an area to better exhibit data? What county/areas?]

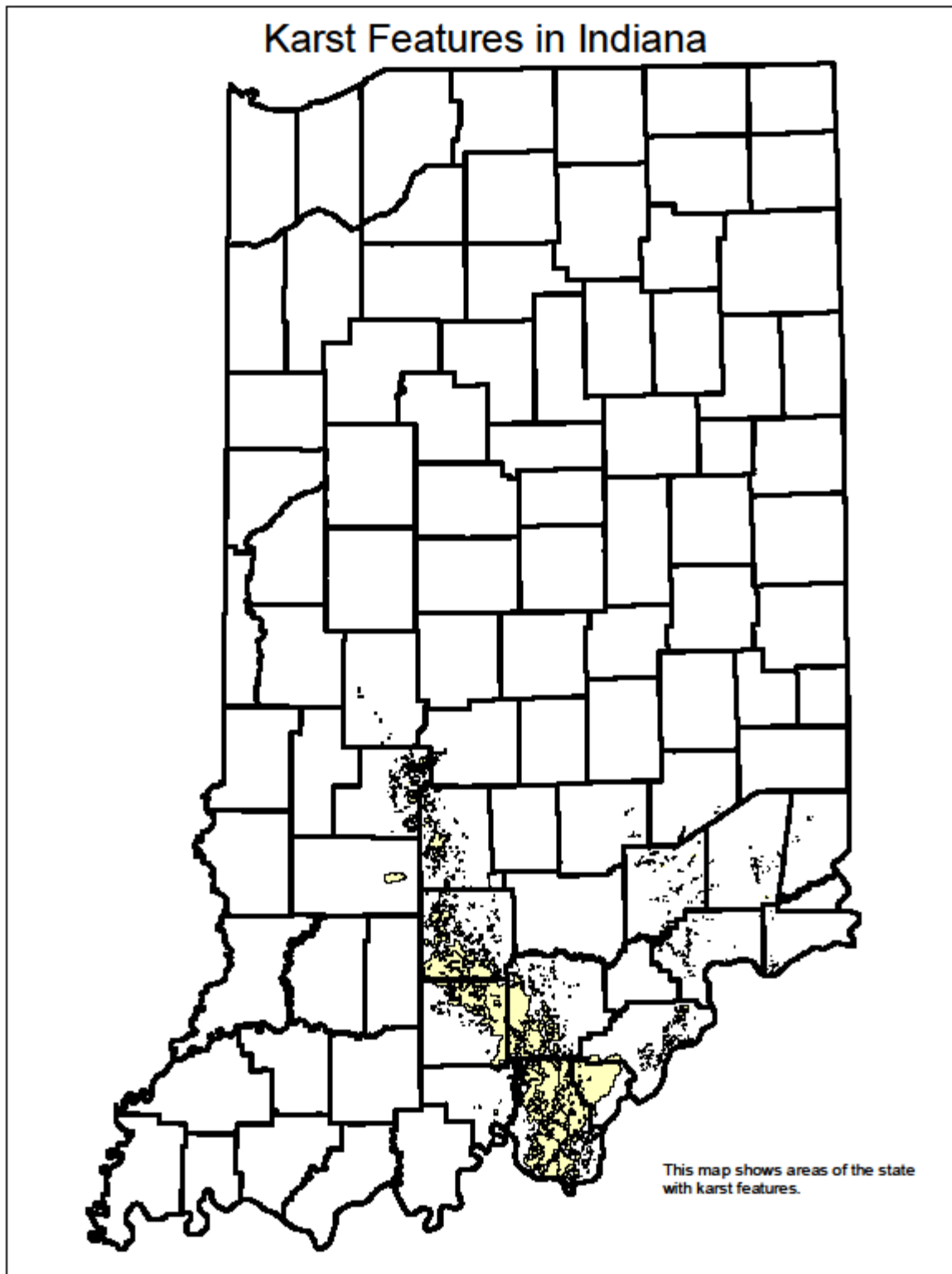
Wells and surface water intake

Public drinking water is particularly important because it is something that Hoosiers can not live without and there are specific health implications where drinking water contains contaminants or toxic elements. Maintaining forests in these areas can lessen the need for expensive water treatment facilities.



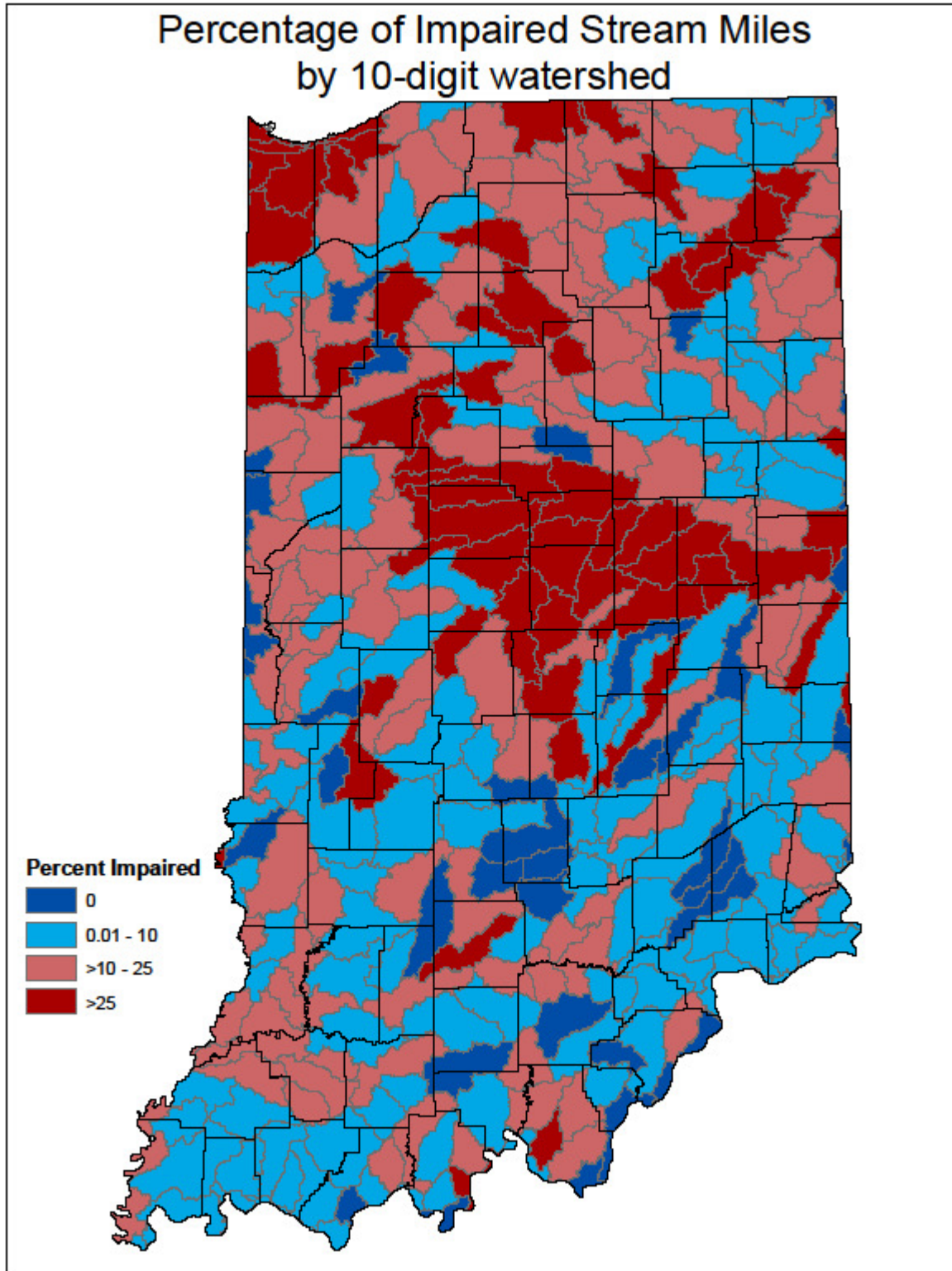
Karst region

Karst regions are particularly susceptible to water quality issues due to the fragility of subterranean ecosystems and the abrupt entry of surface water into underground watercourses through sink holes, caves, etc.



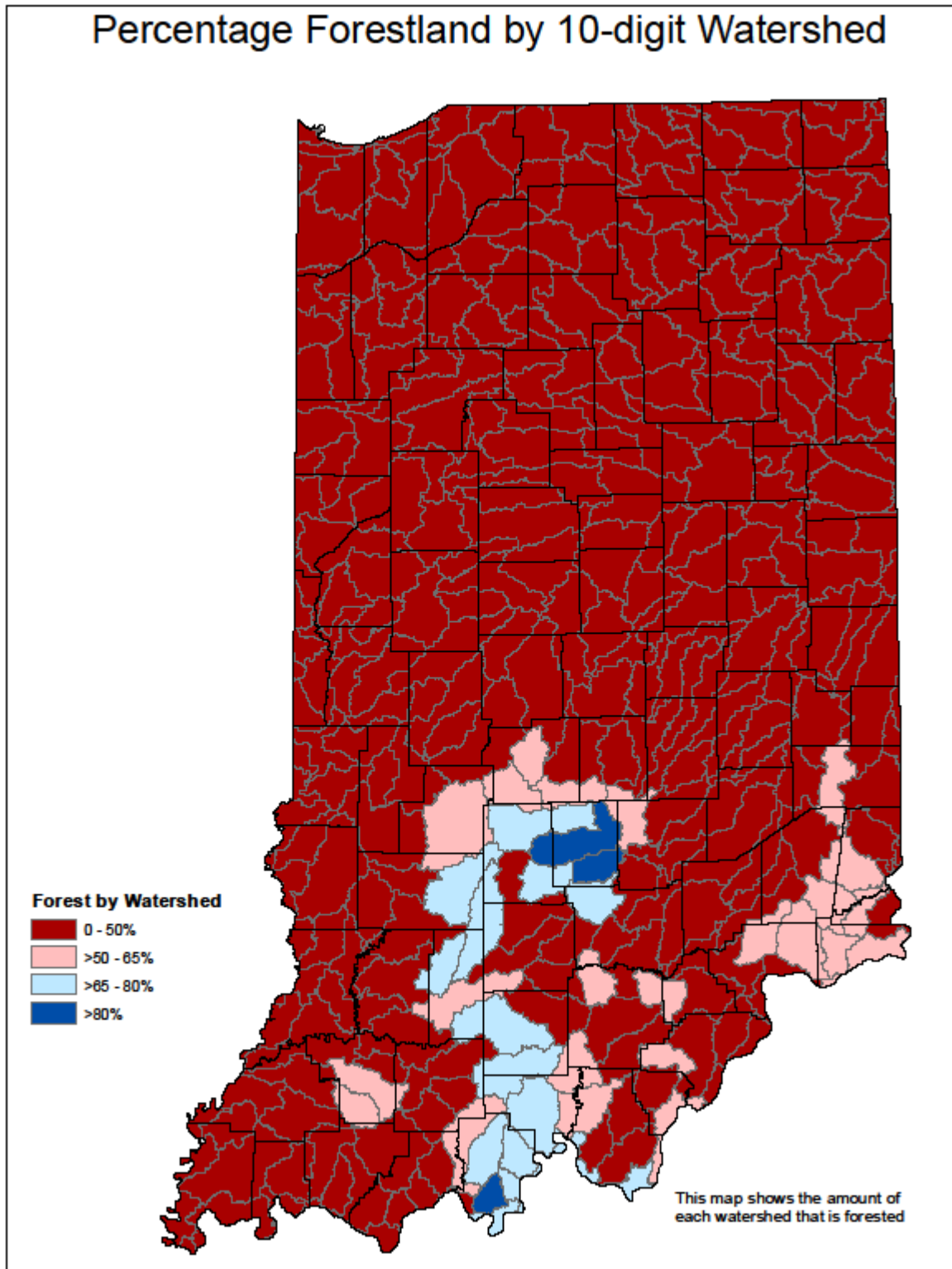
Percent impaired stream length by watershed

Watersheds highlighted red in this map contain the largest number of impaired streams in the State as classified by the Indiana Department of Environmental Management.



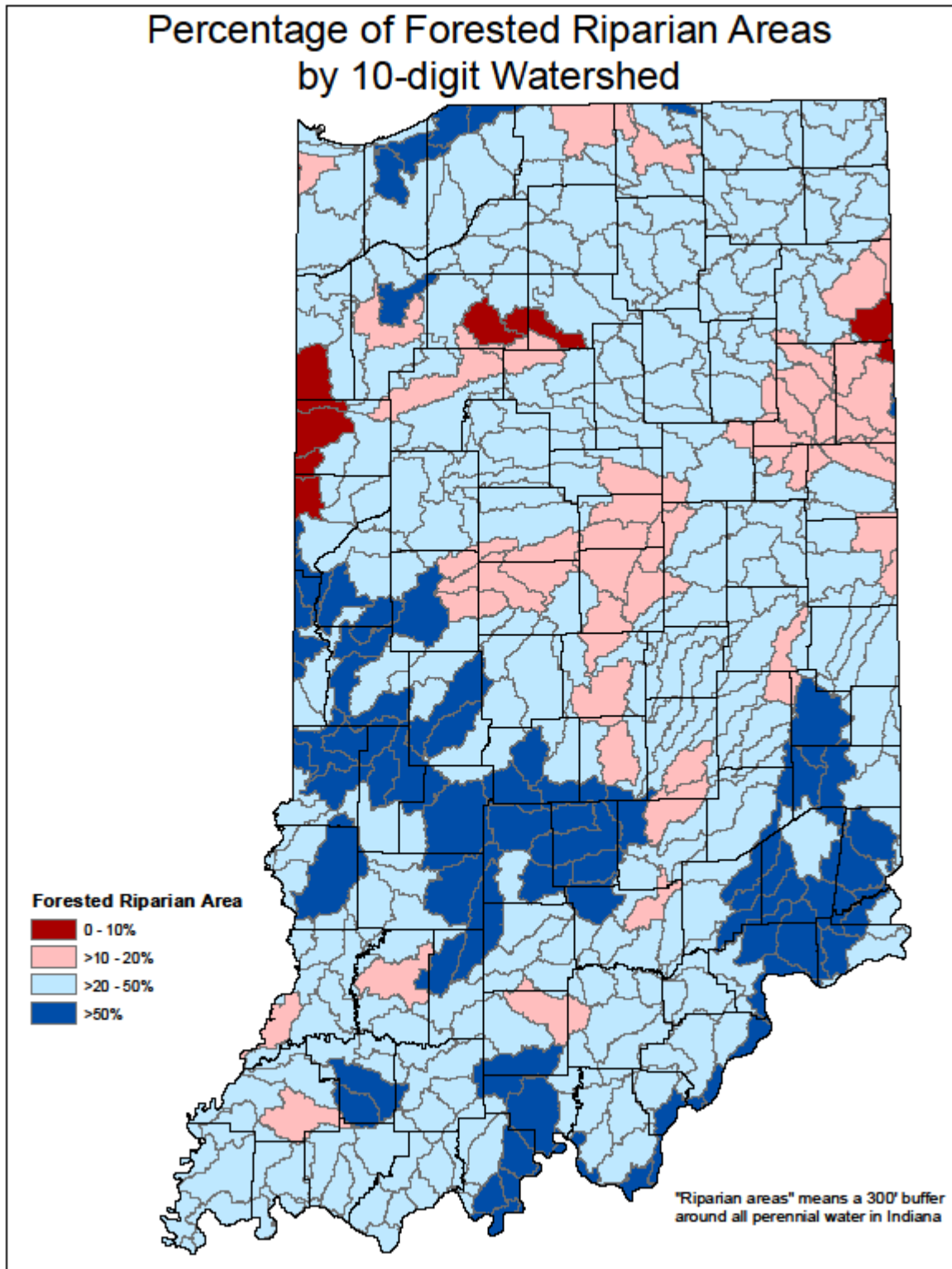
Percent forest cover by watershed

As described above, percentage forestland in a watershed is not the only determinant of a watershed's quality, but the percentage cover does correlate well with the above impaired stream miles. Only 3 of Indiana's 308 watersheds are forested at greater than 80% and these all have 0 impaired stream miles. 17 watersheds have 65-80% forest cover and of these 82% have less than 10% impaired stream miles.



Percent forest cover in riparian corridors

Forested riparian areas are important for the maintenance of soil and water quality and also play an important role in regulating stream and river temperatures requisite for aquatic life. Because these areas are prone to flooding and less amenable to row crop agriculture they are in general less developed and are heavily relied upon as wildlife dispersal corridors.

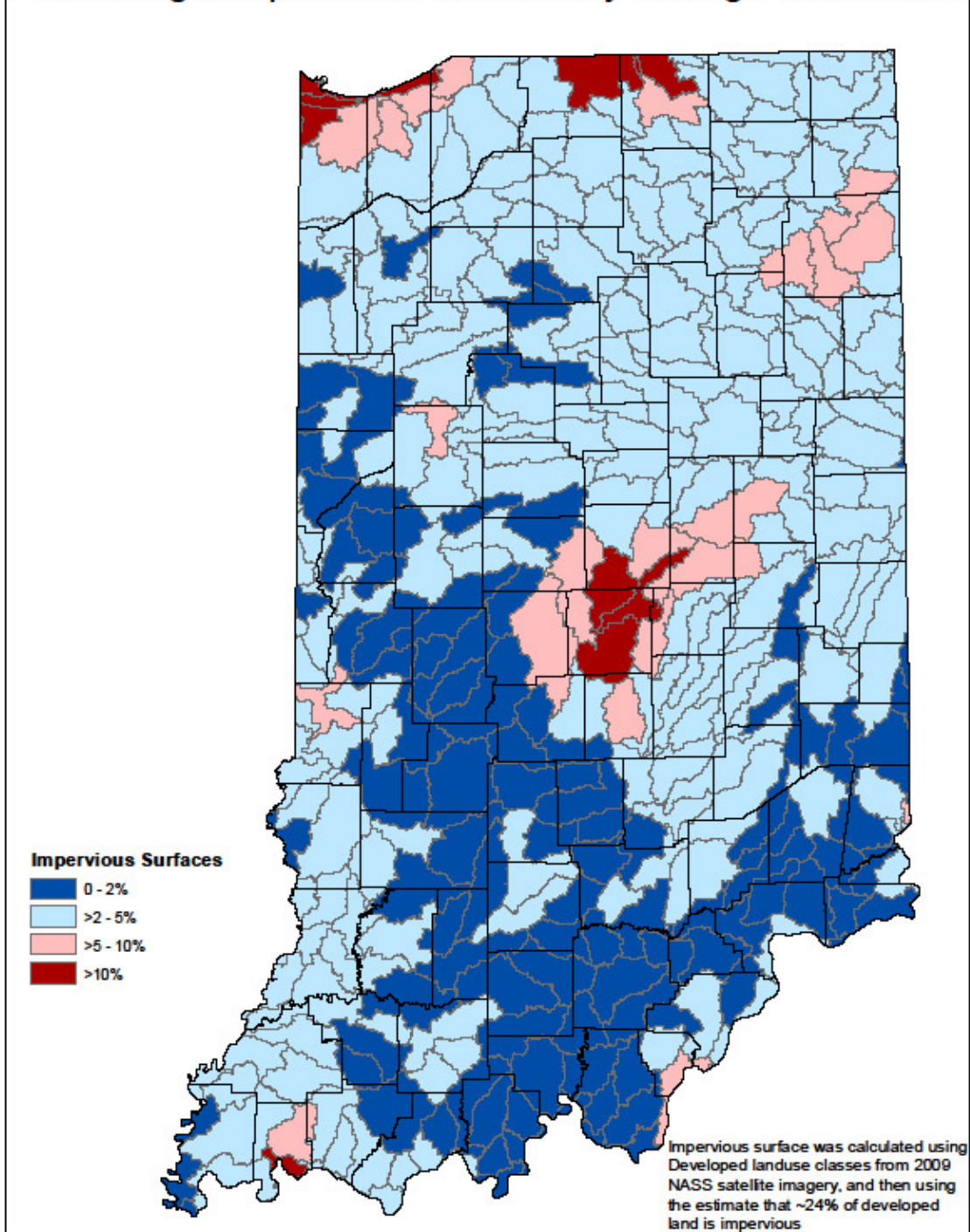


Percent impervious surface by watershed

Toxic and hazardous materials deposited on or associated with roadways and impervious surfaces enter waterways more quickly during rains and floods as they are not filtered or slowed by soil, root, and plant dynamics.

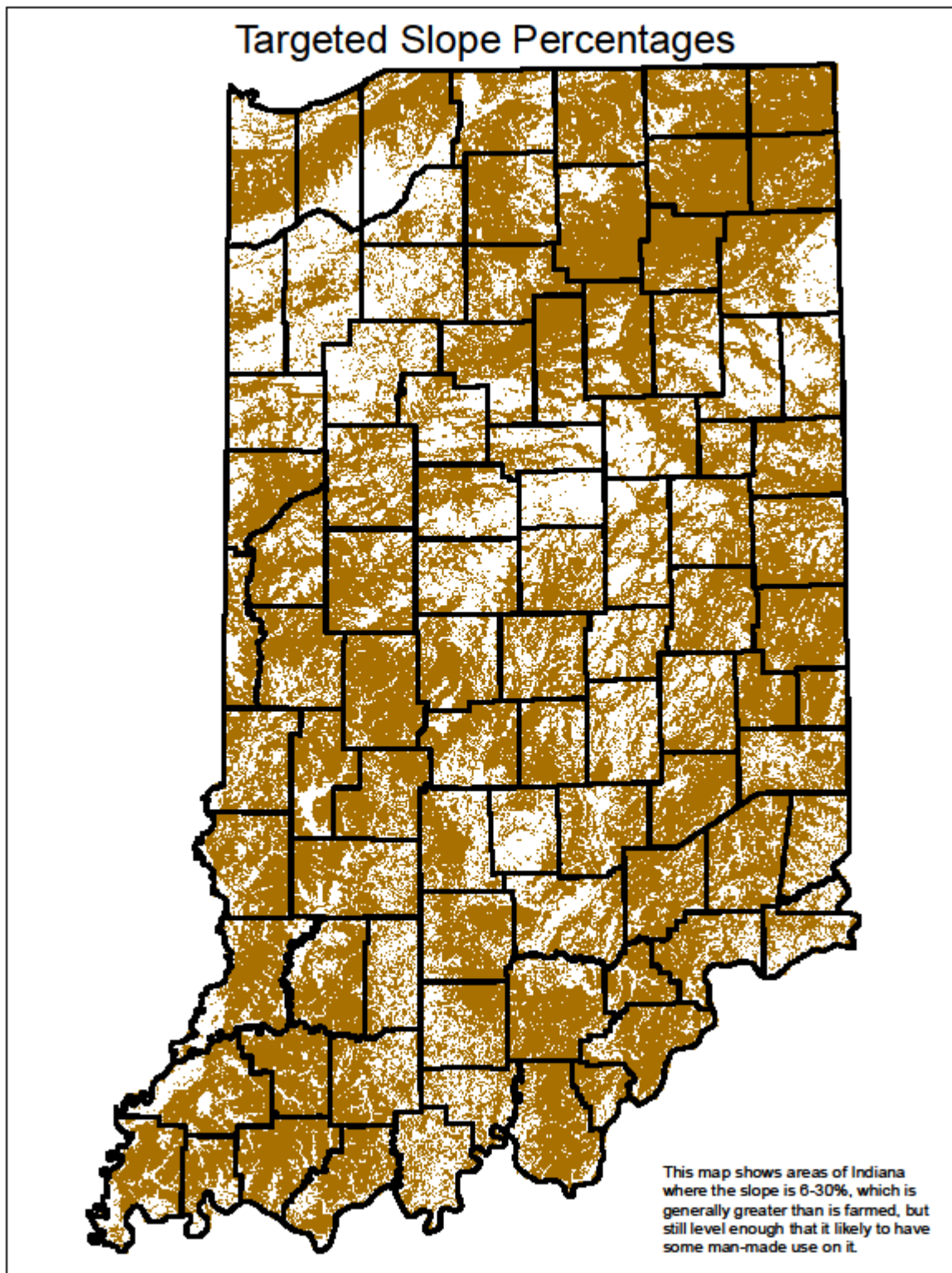
Impervious surface areas are removed from natural ecosystem service functions and comparatively bereft of ecologically beneficial habitat for trees and wildlife. These areas can affect their own climate and create heat islands that further differentiate local ecosystems.

Percentage Impervious Surface by 10-digit Watershed



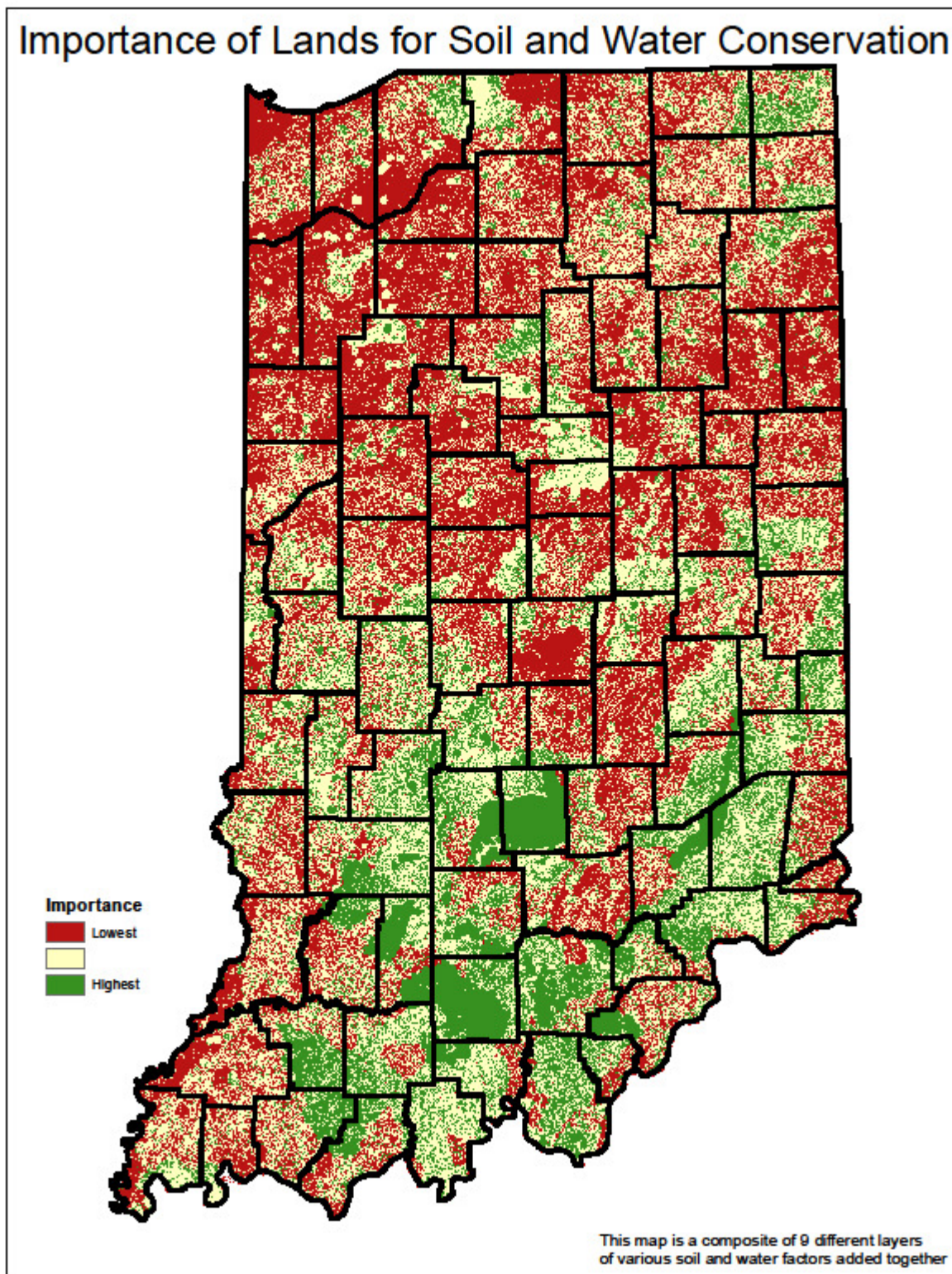
Slope

This map can be considered supplemental to the above NRCS map that also incorporates slope as a factor of importance to forests and the maintenance of soil and water quality. The areas highlighted below are target ranges for forest cover in Indiana based on soil and water conservation cost share requirements. Slope ranges above 30% were considered likely to remain forest cover and those below 6% to remain in row crop agriculture. [Citation?]



Priority Landscape Areas: Soil & Water

The composite map below shows the importance of lands for the conservation and maintenance of soil and water resources and the conservation of forests that protect drinking water supplies. This map should be used to direct forestry related strategic efforts relating to these goals.



Invasives

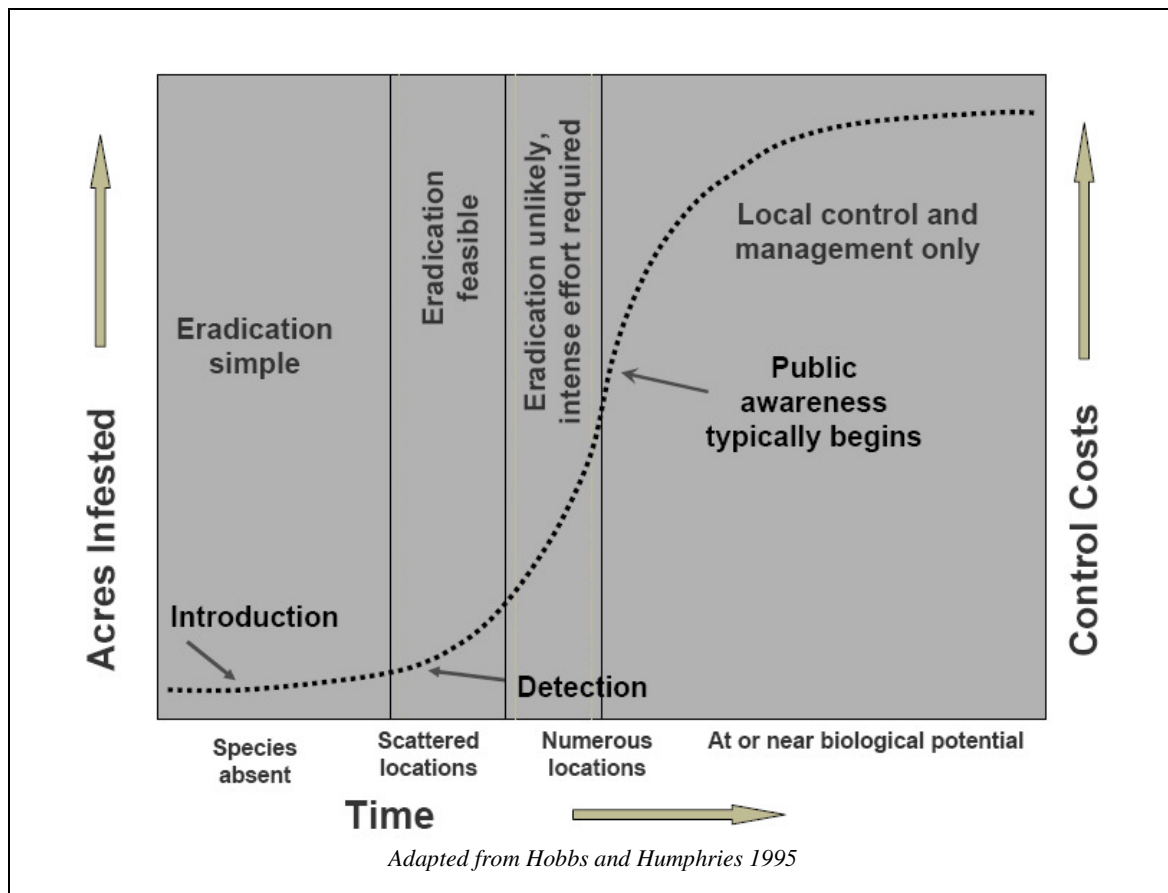
The spread and control of invasive species ranked as the third most important forest issue in Indiana. When considering level of concern as opposed to relative importance, forest stakeholders are more concerned about this issue than fragmentation and conversion of forests to another land use. In fact, many invasive plants exude toxic chemicals that make it impossible for other plants to grow and have the effect of converting diverse native forest stands into acres upon acres of monoculture.

Invasive plants are a threat to forest sustainability in Indiana. Invasions can cause great harm to the environment, economies, human health, and aesthetics. Such invasions threaten biological diversity by displacing native species, as well as altering key ecosystem processes like hydrology, nitrogen fixation, and fire regime.

Indiana's distinction as a hub of transportation and commerce also creates pathways and corridors that accentuate invasive species problems. Humans play a large part in accelerating the introduction and spread of invasive plants in forested communities through the direct planting or seeding of non-native nursery stock. Forest management practices that are conducted without regard for invasive plants or application of BMPs can cause explosive expansions of invasive species like Japanese stiltgrass.

There are a wide variety of plant species able to invade forests. Some, like Japanese stiltgrass and garlic mustard, are shade tolerant and able to establish and spread under undisturbed forest canopies. Others, like Japanese honeysuckle and autumn olive are shade-intolerant but can establish in the understory and abide until the canopy is disturbed and light reaches them enabling rapid spread.

Control and risk of spread is difficult precisely for these reasons. As the graphic below shows, it is not generally until eradication is unlikely that the public becomes aware of an invasive species' inroads.

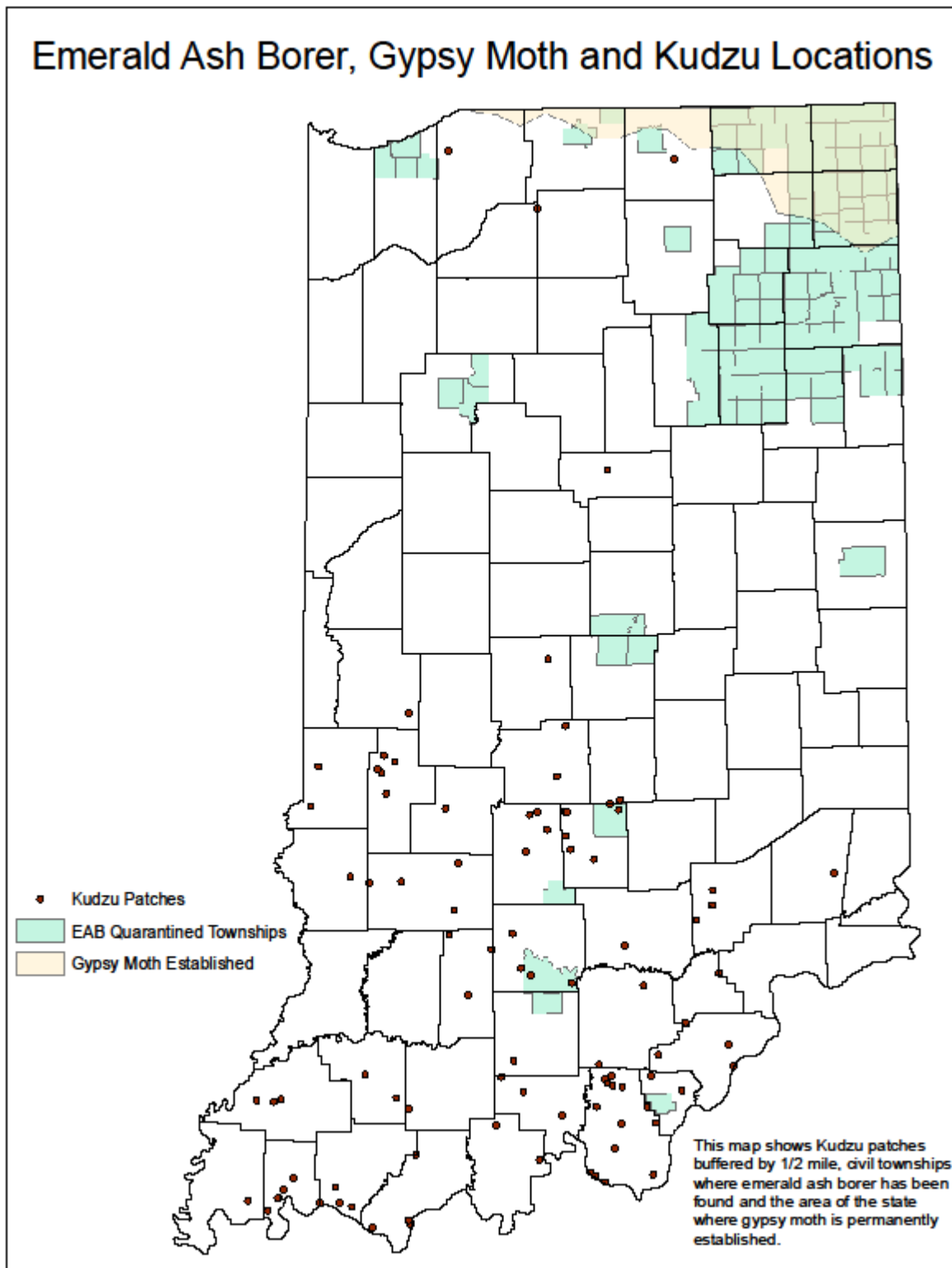


Comprehensive state-level surveys for invasive species do not exist. A coordinated effort to address the impacts of invasive species was legislated in Indiana in 2007 and resulted in the creation of the Indiana Invasive Species Council whose members, as of April 2010, had not yet met. Further information about the forest issue Invasives can be found in Appendix D.

There are 3 component maps relating to invasive species.

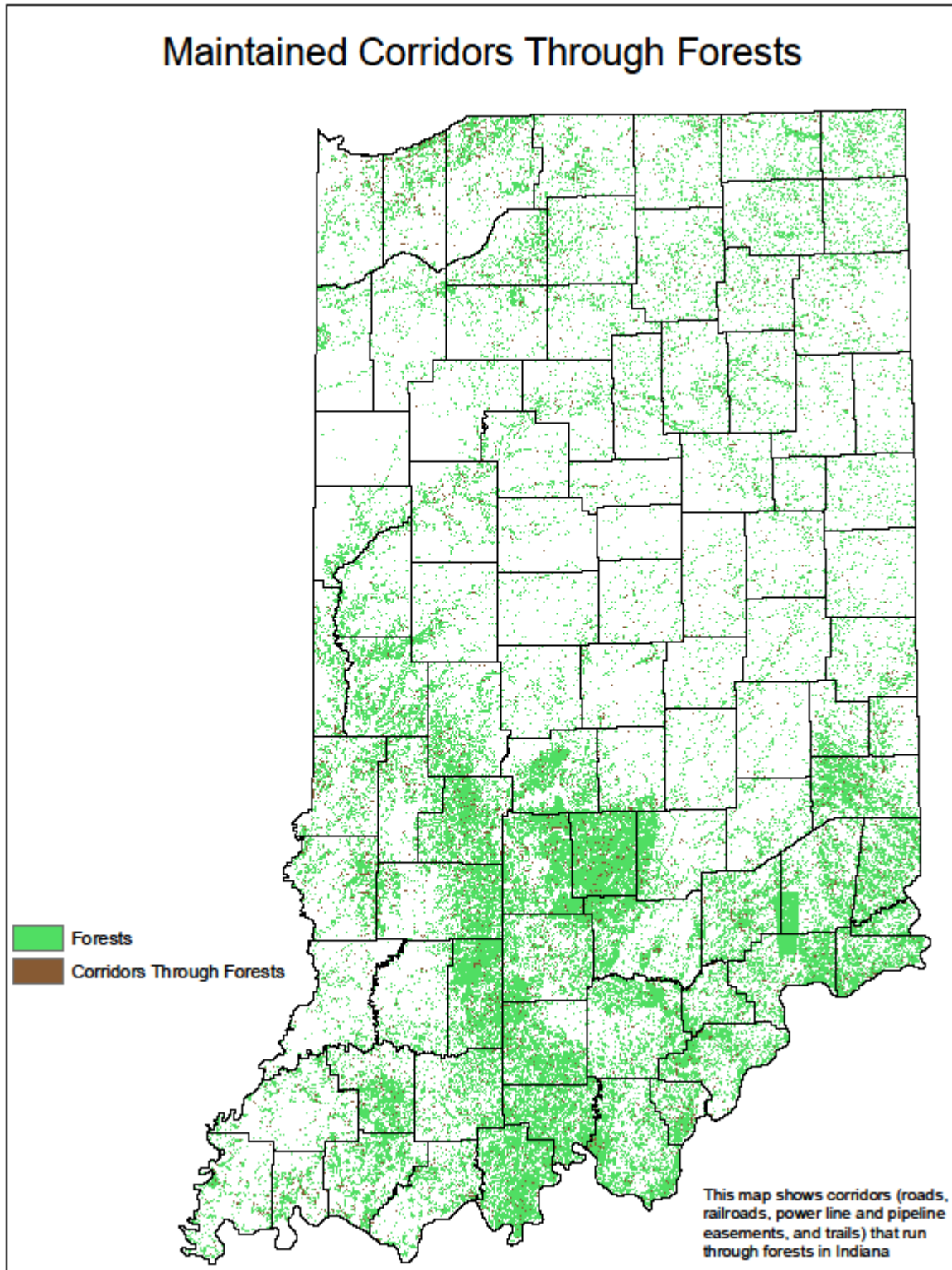
Known statewide invasives occurrence

The IDNR tracks the spread of the Emerald Ash Borer and Gypsy Moth. The USDA Forest Service has provided information relating to known sites of Kudzu infestation. These occurrences cover only a small number of the invasive species that threaten Indiana's forests but represent the results of systematic, statewide surveys that have occurred over a number of years.



Forest corridors

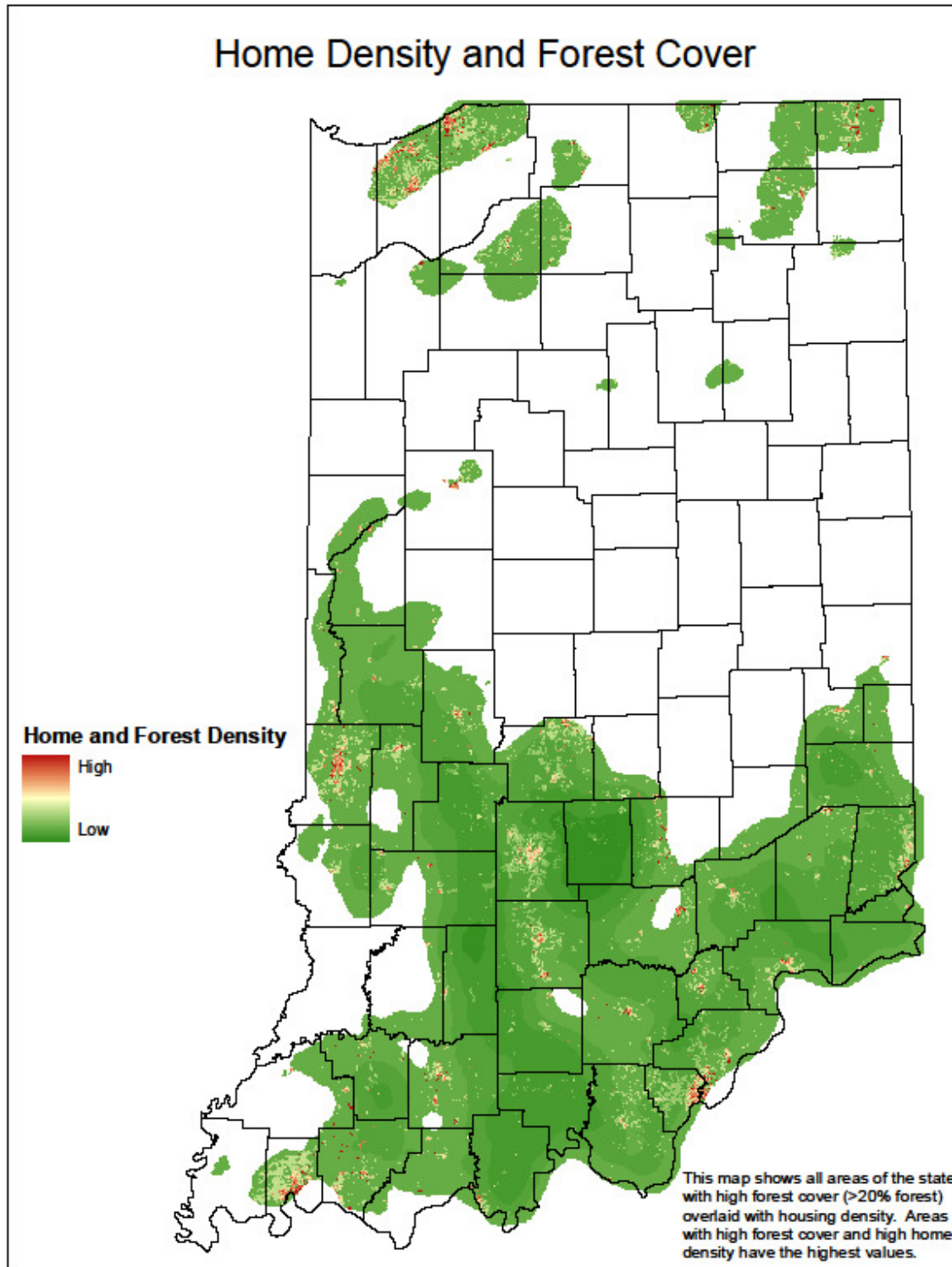
Invasive species spread by a variety of means but have been shown to travel effectively through maintained forest corridors. Those shown below are traveled by people, machines and animals and are maintained in early successional habitat to promote their accessibility and designated use.



[Would this topic benefit from the inclusion of an additional map that highlighted a county or zoomed in on an area to better exhibit data? What county/areas?]

High home density and high forest cover

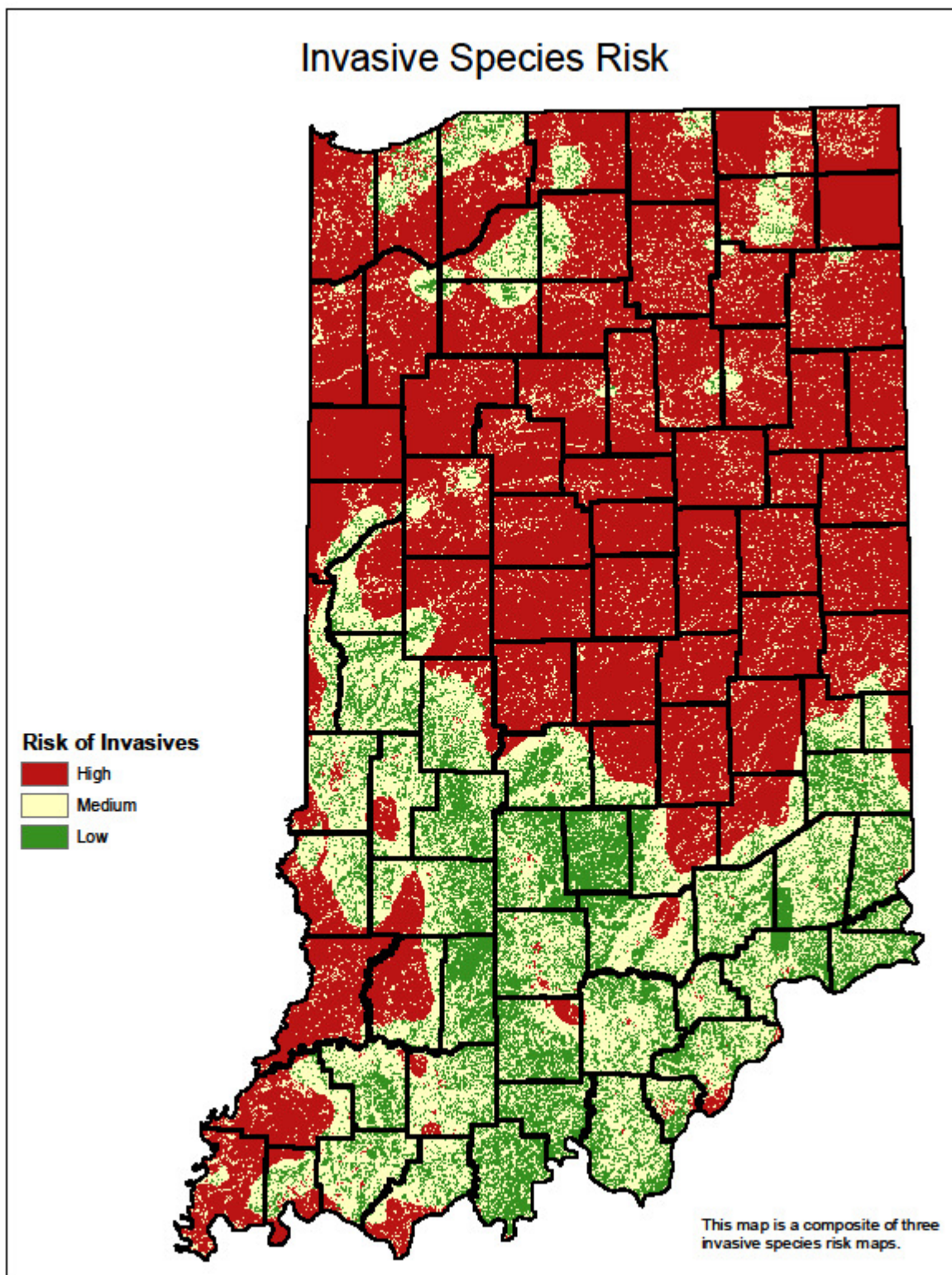
This map attempts to identify risk to forests from invasive spread through landscape plantings or other method relating to exchanges between areas of high forest cover and high home density. Nursery catalogs list a number of known invasive species, like Autumn and Russian Olive that are legally shipped and planted in Indiana. Exotic plants are often promoted and planted before their invasive qualities are full assessed because they exhibit disease and pest resistance.



[Would this topic benefit from the inclusion of an additional map that highlighted a county or zoomed in on an area to better exhibit data? What county/areas?]

Priority Landscape Areas: Invasives

This map projects invasive species risk based on statewide survey locations of known invasives, forest corridor dispersal and overlapping high forest and high home density areas. Similar to risk of fragmentation, strategies to combat invasive species spread should focus on areas that are listed as low risk.



Biodiversity

"To keep every cog and wheel is the first precaution of intelligent tinkering."
- Aldo Leopold

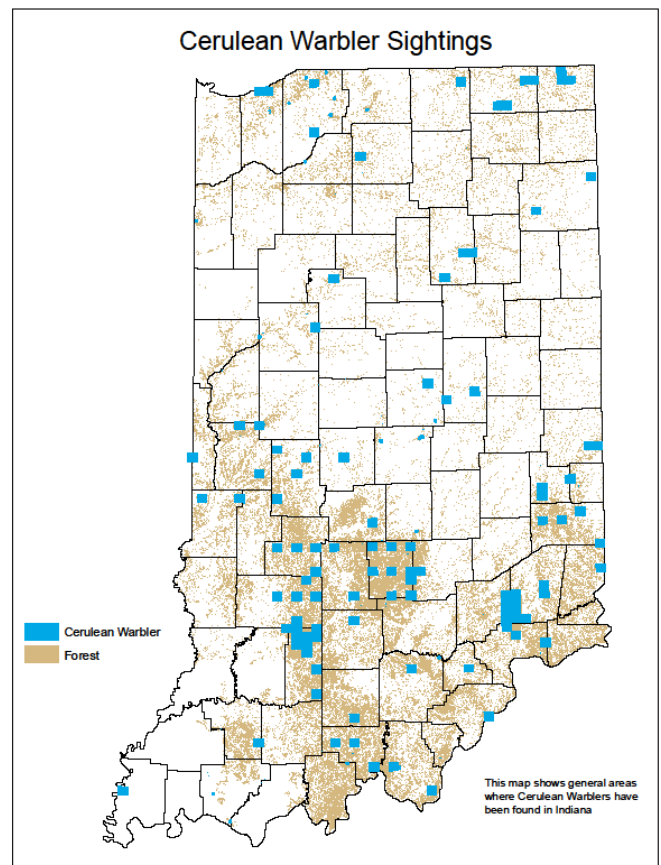
Conservation of biological diversity ranked as the fourth most important issue in the June 2009 Survey of Indiana forest stakeholders and only 15 out of 1,294 respondents were not concerned about it.

Biologic diversity is perhaps the most important overall measure of ecosystem health and well being. Forest stakeholders respond strongly to this issue because it is also a measure of our own health and the well being of society as a whole. Remarkable genetic similarities between humans and other life indicate that the environmental stresses that are threatening the existence of certain species are affecting us as well.

Biodiversity includes all plant and animal species, species of special concern and common species and it exists upon a similar diversity of habitat types at various states of succession. This vast complexity is difficult to represent spatially.

This section focuses on identifying priority areas relating to forest biodiversity and attempts to delineate areas based on select, defining factors. Statewide survey information relating to stand age and forest type does not exist at a relevant scale to be useful for focused landscape scale initiatives. This is a major data gap that may be addressed in the near future with technological advances in the area of forestry remote sensing (like LIDAR - Light Detection And Ranging).

Without these data it is difficult to address certain other identified issues that have specific relation to forest biodiversity for example, sustainable regeneration of oak woodlands. Oak species are a great determinant of diversity in certain areas because of the large number of insect and animal species that depend upon them. Beyond the more generally recognized large game species like deer and wild turkey that depend on oaks, research shows that the *Quercus* genus supports the greatest number of butterfly and moth species whose larvae are the most important source of protein for Neotropical migratory birds like the forest dependent and federally endangered Cerulean Warbler (see map). (Tallamy, 2008)



The need for high resolution stand-age class and forest-type data across the State are highlighted by considering two statistics from the USDA Forest Service. Their Forest Inventory and Analysis program shows that the oak-hickory forest type (72%) dominates all other forest cover type groups in Indiana. FIA also shows that 90% of stand age classes fall between 20 and 99 years (FIA, 2008). These data point towards unsustainable characteristics that necessitate further research and understanding.

Indiana's oak-hickory component developed largely from existing seed sources maintained by Native American burning practices, regeneration and succession in full sun, open canopy conditions and in the general absence of deer herbivory (extirpated from Indiana by 1900). These conditions do not and can not exist today as they have in the past and there is question whether shade intolerant species like oaks, butternut and black cherry, among others will have a place in Indiana's forests of the future without a defined effort to maintain them in the mid and under-stories of forests. Statewide high resolution information about these forest characteristics is currently a data gap.

The extreme dominance of age classes between 20 and 99 years threatens ecological simplification and the loss of species diversity especially among those species traditionally found in Indiana following the forest recovery, like ruffed grouse, dependent on early successional habitat.

Species of greatest conservation need associated with early or late successional habitat: Ruffed Grouse, Allegheny Woodrat, Golden-Winged Warbler, Timber Rattlesnake, Cerulean Warbler, and Whip-Poor-Will. (IDNR)

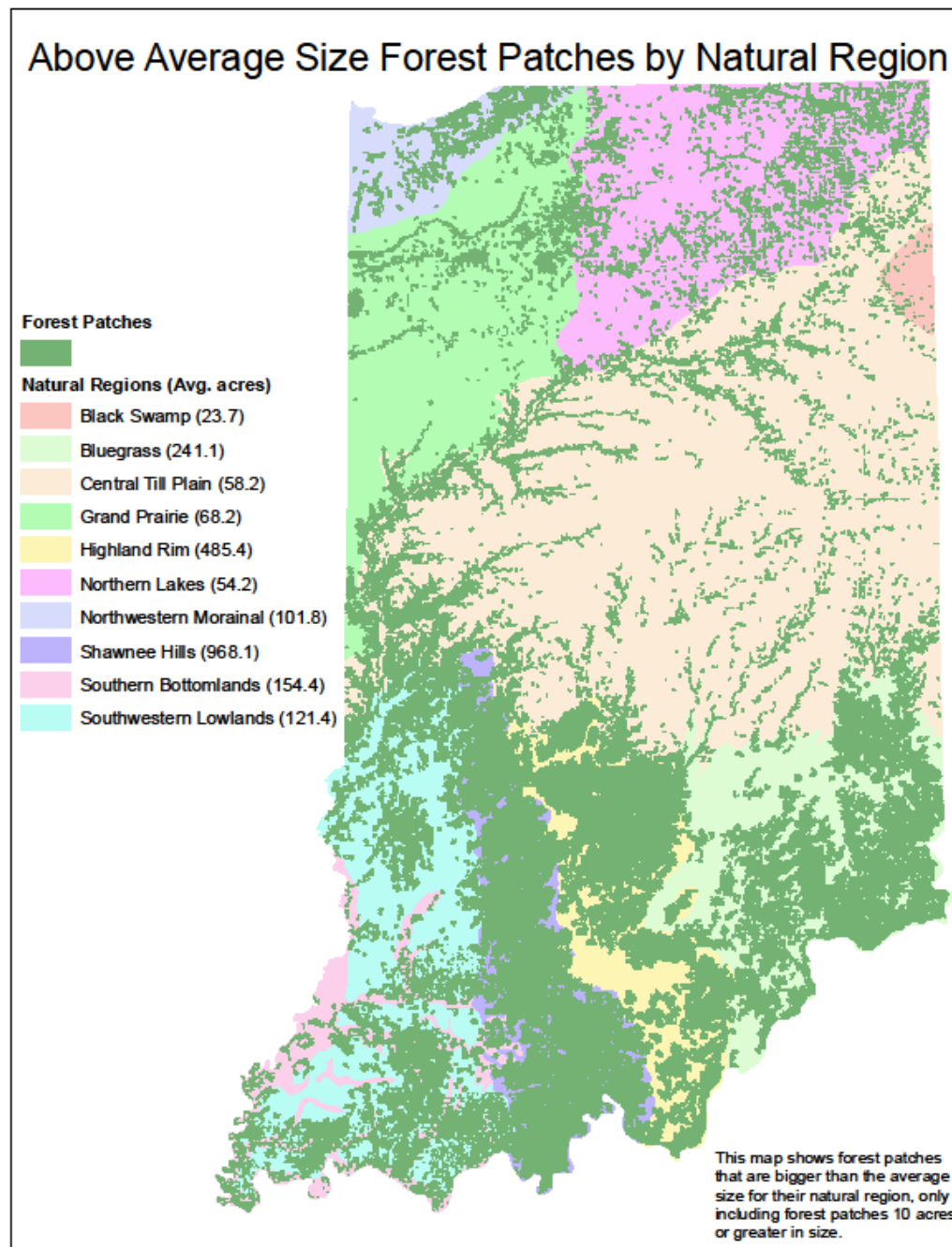


Further information about the forest issue Biodiversity can be found in Appendix D. This issue has four equally weighted component maps.

Larger than average contiguous forests by eco region

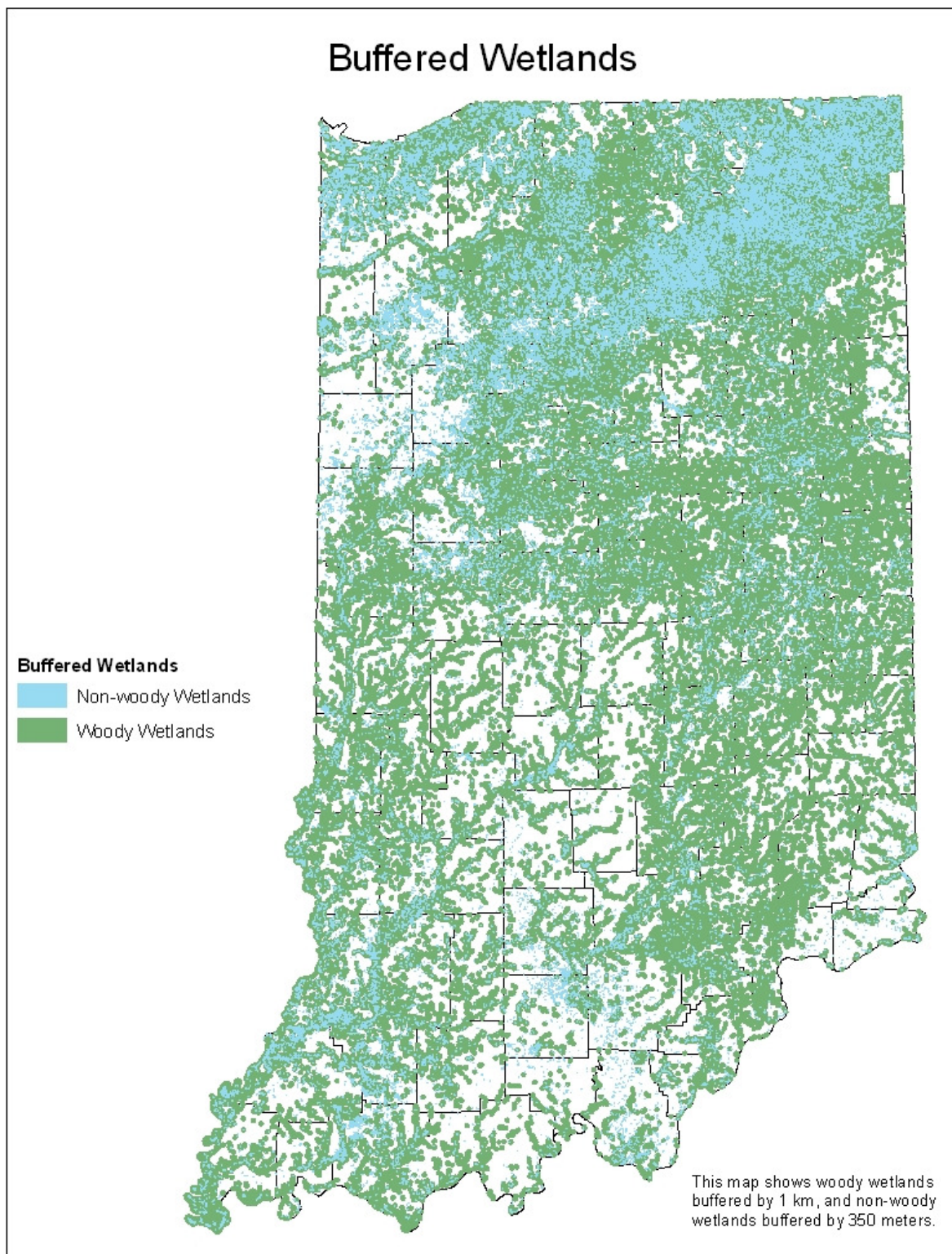
The Natural Regions of Indiana were developed by Michael A. Homoya of the IDNR Division of Nature Preserves. These regions represent an ecologically unique partitioning of the State based on natural geologic or climactic factors. A region's biologic diversity will be reflective of these inherent elements shaping the surrounding ecosystem. Thus, each natural region can be expected to present unique characteristics that suit particular organisms and forested habitats.

This map shows above average size forest patches for all Homoya's Natural Regions. Average size patch for each natural region is shown next to its name in the map legend. By this method, natural variations should capture unique attributes that might be overlooked with a focus only on species richness. It is assumed that larger forest patches generally offer more suitable habitat for biologic diversity and present a greater capacity to exist into the future.



Wetlands with buffers

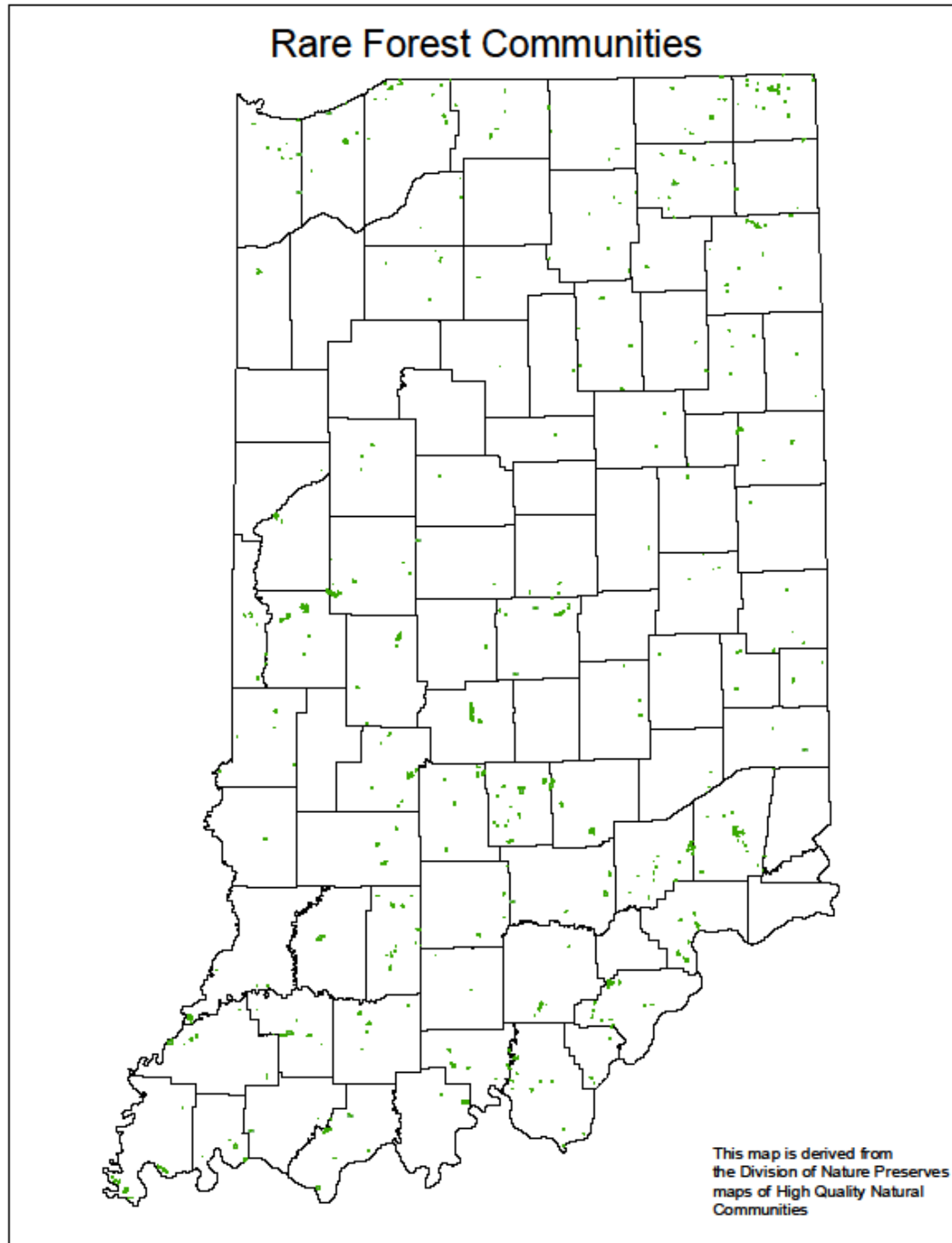
Generally, researchers have found increases in the proportion for forest cover correlates to increases in forest species richness and diversity within these groups. For instance, areas with higher proportions of forest canopy within 1 km of forested wetlands often have higher species richness of forest amphibian species (Knutson et al. 1999, Herrmann 2005).



Imperiled natural community types

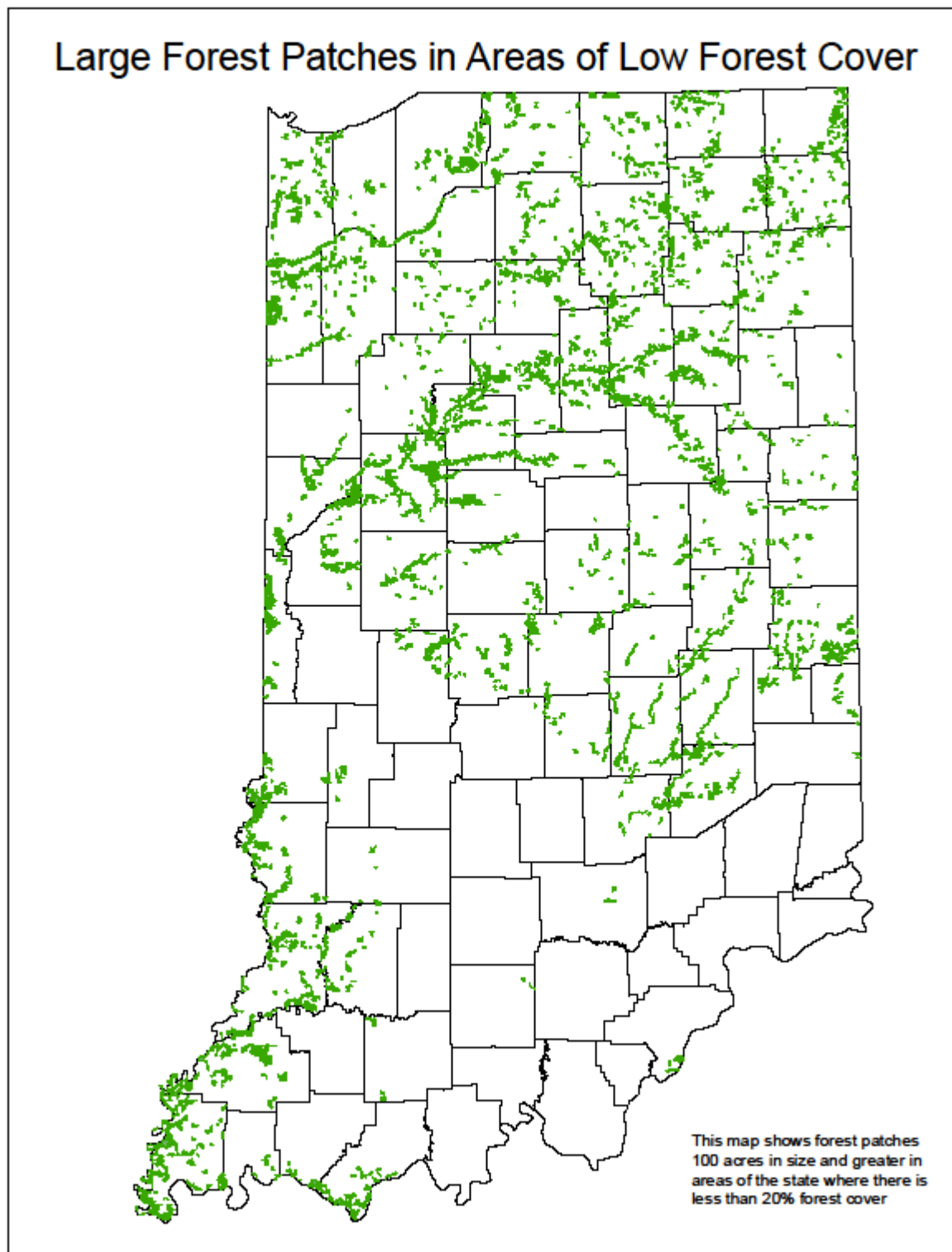
This map illustrates locations of the best quality occurrences of the various forest community types within the Natural Heritage Data Base.

The Indiana Natural Heritage Database is a digital, geospatial file containing information on Indiana's rare or otherwise significant natural features, including plant and animal species, natural communities, and animal aggregations. It lists locations and dates of occurrences or sightings, of both federal and state endangered species, including specific latitude and longitude for points of occurrence. The database was compiled from numerous sources including museums, herbaria, publications, and the results of fieldwork by many individuals.



Large forest patches within low forested areas

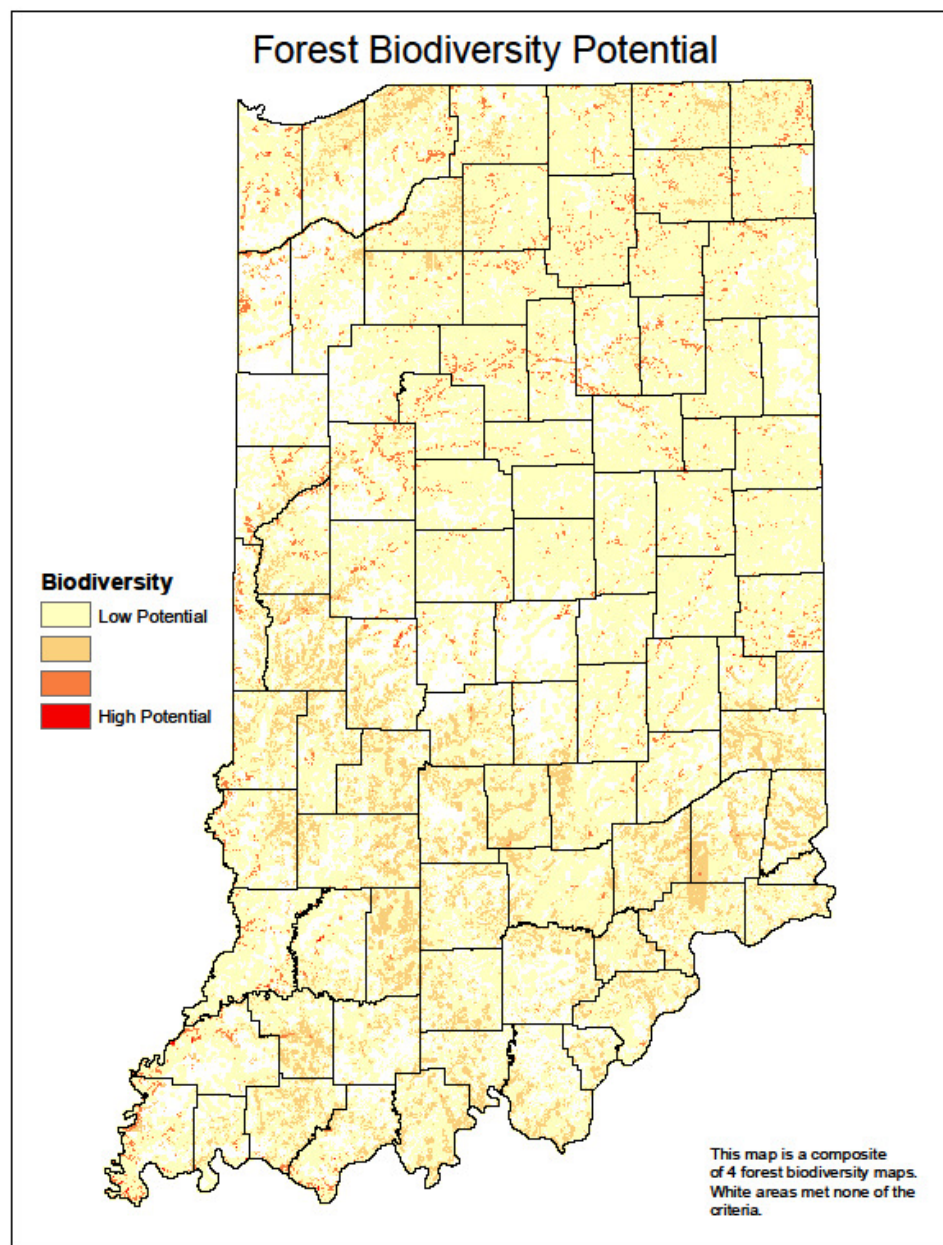
This map exhibits forest patches of greater than 100 acres in size in areas that have less than 20% forest cover in the surrounding 10KM. In the vast majority of these areas, these patches can be considered refugia for species that remain and highly important to dispersal, migration and other ecologic functions.



Priority Landscape Areas: Forest Biodiversity

This map combines larger than average forest patches by natural region, forested wetlands with a one kilometer buffer, rare or imperiled forest communities and large forest patches in areas of low forest cover to create areas with a relatively greater propensity to contain forest biodiversity. Areas meeting all four categories are highlighted in bright red.

These areas should be a focus for conservation and landscape scale stewardship initiatives whose main goals are the conservation and maintenance of biological diversity. A significant component of efforts in these areas will involve the linking of habitats and provision of dispersal corridors. This Assessment does not provide guidance on connectivity and dispersal corridors. This is a major data gap and potentially involves analysis that is more aptly presented in the Statewide Forest Resource Strategy.



[Would this topic benefit from the inclusion of an additional map that highlighted a county or zoomed in on an area to better exhibit data? What county/areas?]

Recreation

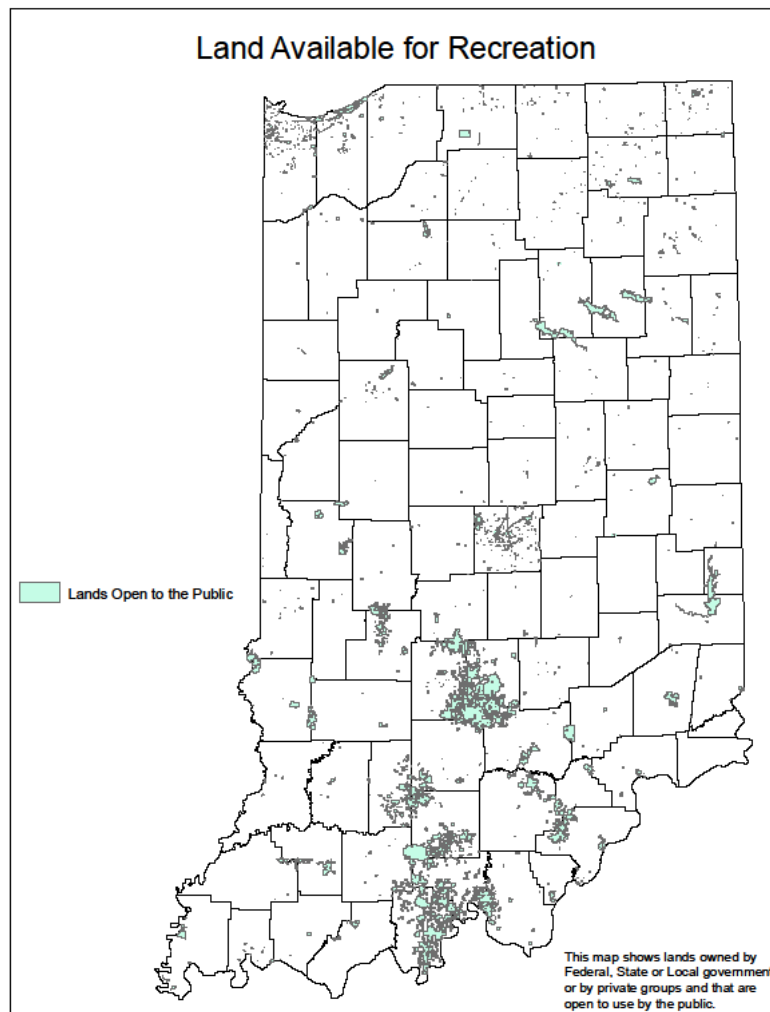
The availability of land for public recreation is an important issue for Indiana's forest stakeholders. Its importance rank was significantly less than that of the four issues discussed previously but recreation, similar to the wood products industry described below, is a significant driver of conservation, research and federal monies dedicated to forests and both offer an opportunity to link economically to the values and benefits that woodlands provide.

Inherent in recreation is the opportunity to address other important and identified forest issues: inadequate public education about forests, overpopulation of white-tailed deer and inadequate youth education about forests. Public and youth education about forests is enhanced and made relevant with increased outdoor experiences. And hunting is a major component of recreation that offers perhaps the only viable method to control deer populations.

This map shows the areas in Indiana that are open to the public for recreation. These lands encompass 12.3% of Indiana's forests.

Further information about the forest issue Recreation can be found in Appendix D. This issue has one component map.

Federal and State lands open to the public



Wood products

Sustaining Indiana's forest products industry is an issue that stakeholders are concerned about although it does not rank as high as previous issues in terms of relative importance (See page 2). This section is generally concerned with assessing the importance of forestlands in relation to the provision of a specific ecosystem service – timber production.

Because society demands wood and wood products for a multitude of uses, economic value is assigned to the standing timber that is the raw material for its production. For Indiana's forests, this is arguably the most important link to an economic system within which forests accrue annual costs of management, oversight and property taxes. Until there develop additional markets for ecosystem services, like the provision of clean water or carbon sequestration benefits, the harvest and sale of timber will likely continue to be the main contributor to the economic value of forestland, maple sugaring and hunting leases notwithstanding.

Speculative investment in forests for associated development land values that are based on the future parcelization and conversion to another land use and are not reflected in this analysis.

Forestry and wood product manufacturing is a \$7.5 billion industry that employs over 54,000 Hoosiers and Indiana has developed a global reputation for excellence in hardwood tree production and product manufacturing. However, growing competition from wood product manufacturers in Asia, Latin America and elsewhere threatens the viability of Indiana's hardwood industry (ISDA, 2009).

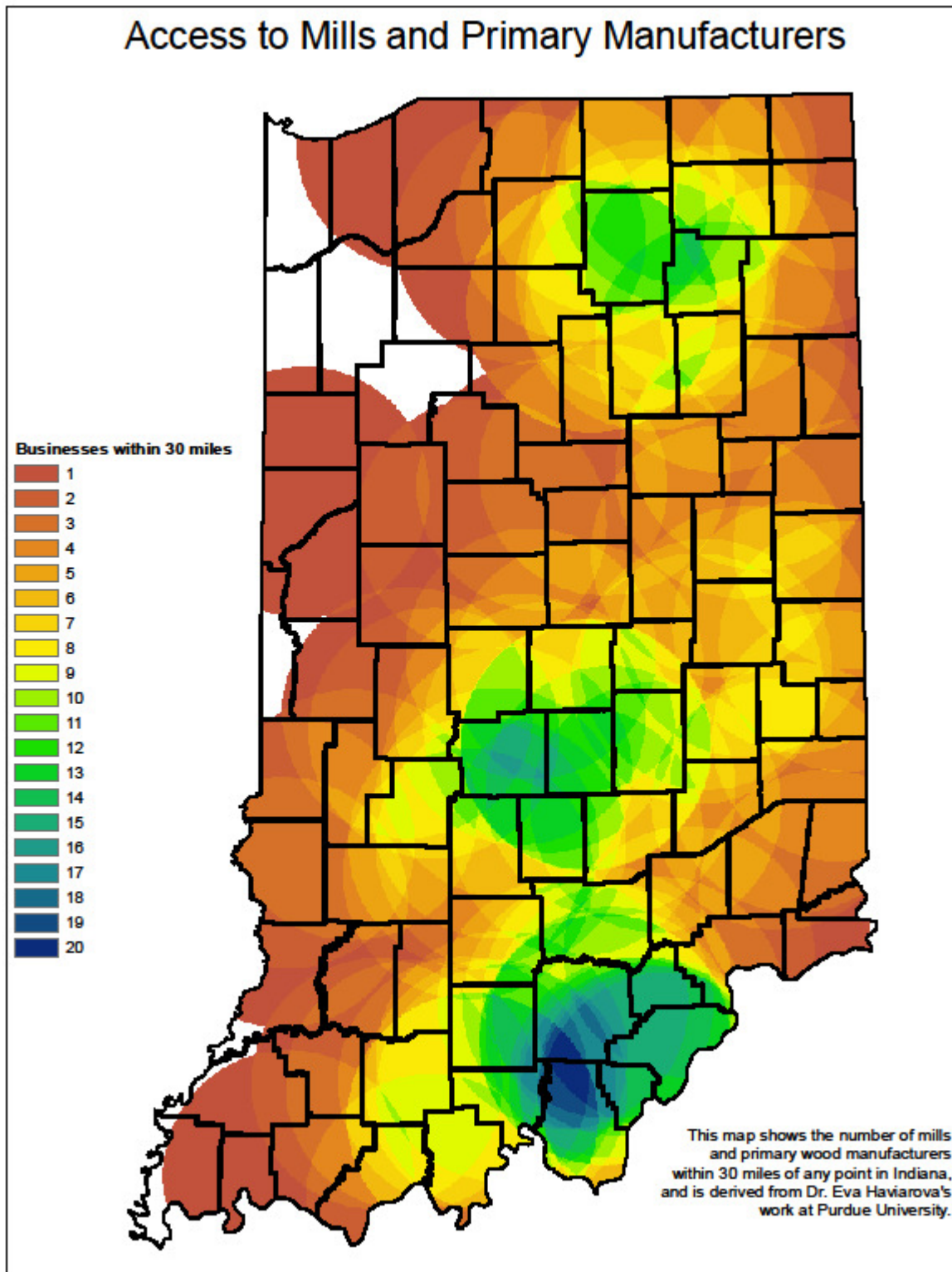
Seeking to differentiate Indiana's environmentally sound, high quality and legally sourced wood products has resulted in a branding effort called "Premium Indiana Forest Products" and the third party certification of sustainably grown, harvested and manufactured forest products through groups like Sustainable Forestry Initiative (SFI) and Forest Stewardship Council (FSC). Sustainably certified forestlands represent a growing share of the managed forests in Indiana and the majority of these are highlighted in this analysis.



Indiana has ranked first nationwide in recent years in the production of wood office furniture, wood kitchen cabinets, and hardwood veneer, along with several other products. As small family-owned businesses, wood products companies average less than 50 employees and play an important role in rural communities (IDNR, 2010). The Division of Forestry has fostered efforts to connect disparate groups with a forest commerce website established recently called The Indiana Forestry Exchange: www.inforestryx.com

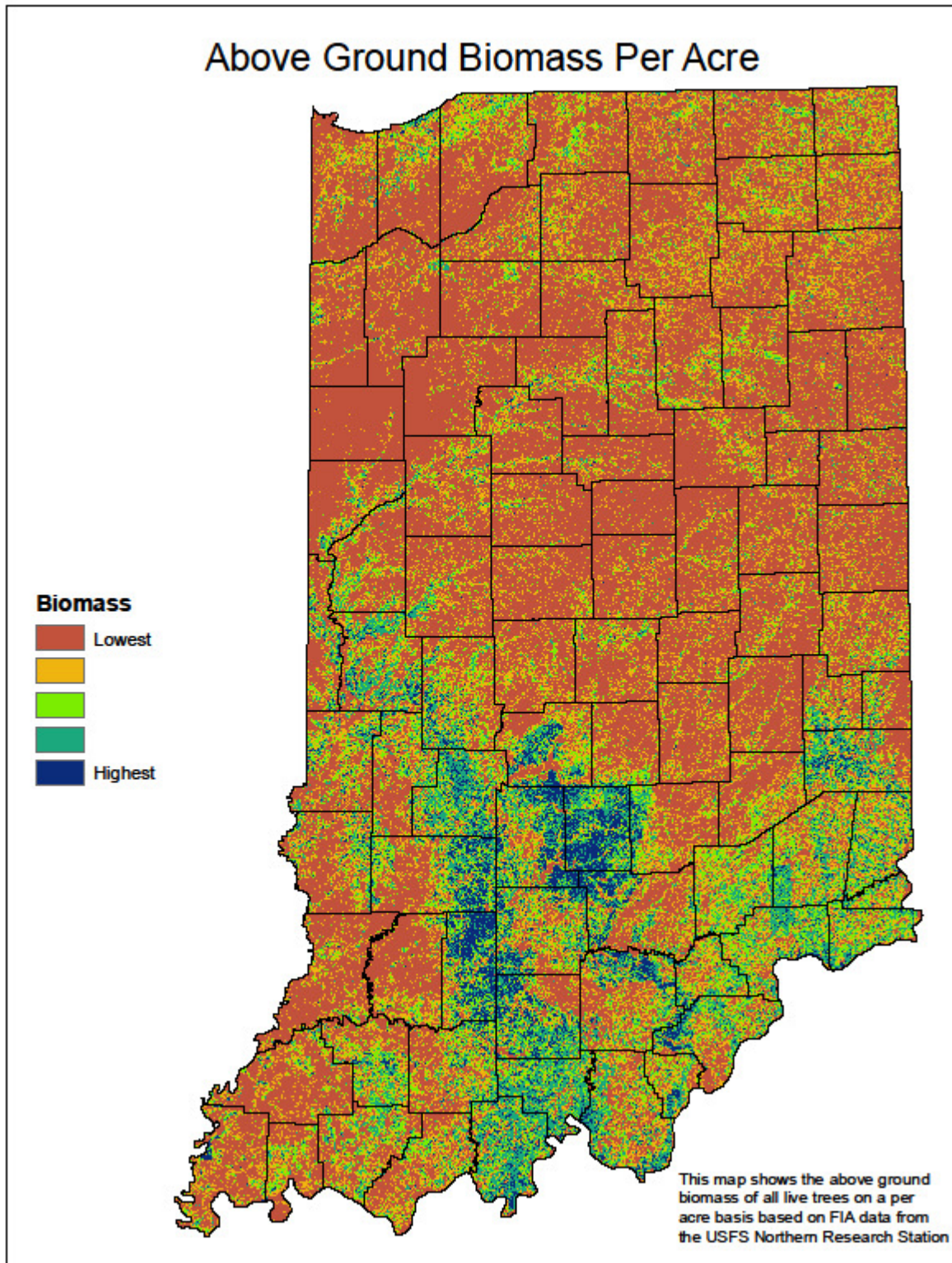
Further information about the forest issue Wood Products can be found in Appendix D. This issue has four equally weighted component maps.

This map shows the distance to saw mills and primary manufacturers who are the major purchasers of standing timber and delivered logs for processing. Transportation costs are an important component of timber production and marketing and a 30 mile radius is often used in the industry to assess costs.



Biomass

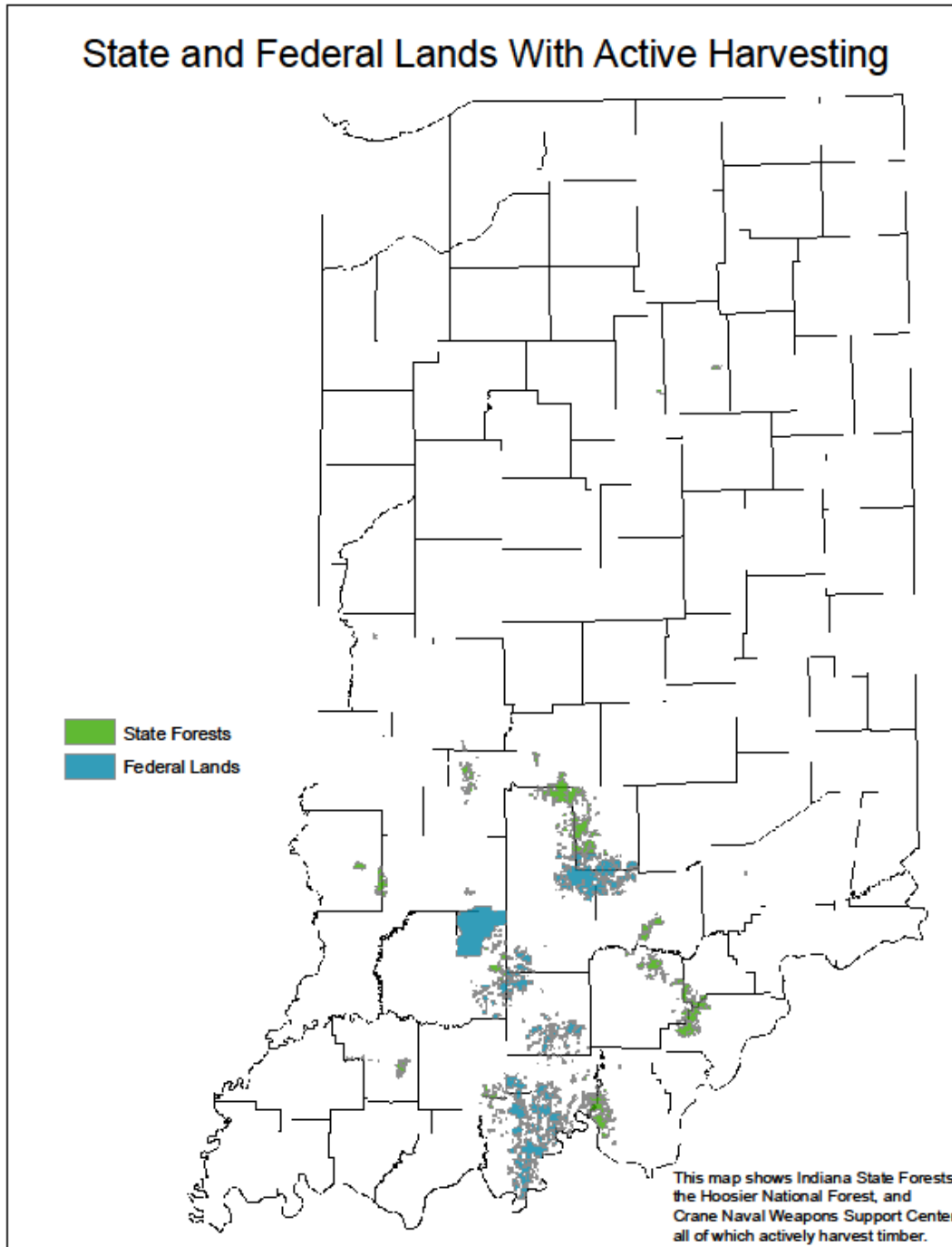
The map below shows the above ground biomass concentration in the State of Indiana. Biomass can be a relative indicator of potential timber and other industrial use but is not necessarily related to an area's productive capacity. The measure of an area's productive capacity (site index) is not accurately and consistently available on a statewide basis. This is an identified data gap and research is underway to provide this information across the State.



State Forests, Crane and Hoosier National Forest managed lands

This map shows areas of public ownership that currently have a regular or active timber management program on a portion of their property. Public properties that are managed in part for timber make up 44% of public lands in the State. This number is an overestimate because it includes a property's entire ownership and does not select out the areas, like nature preserves in State Forests or the Deam Wilderness in Hoosier National Forest, that do not have regular timber management.

These lands are important because their larger overall areas offer greater opportunity for landscape scale continuity in management and relative economies with respect to harvesting practices. These lands make up 6.7% of the forestland in Indiana.



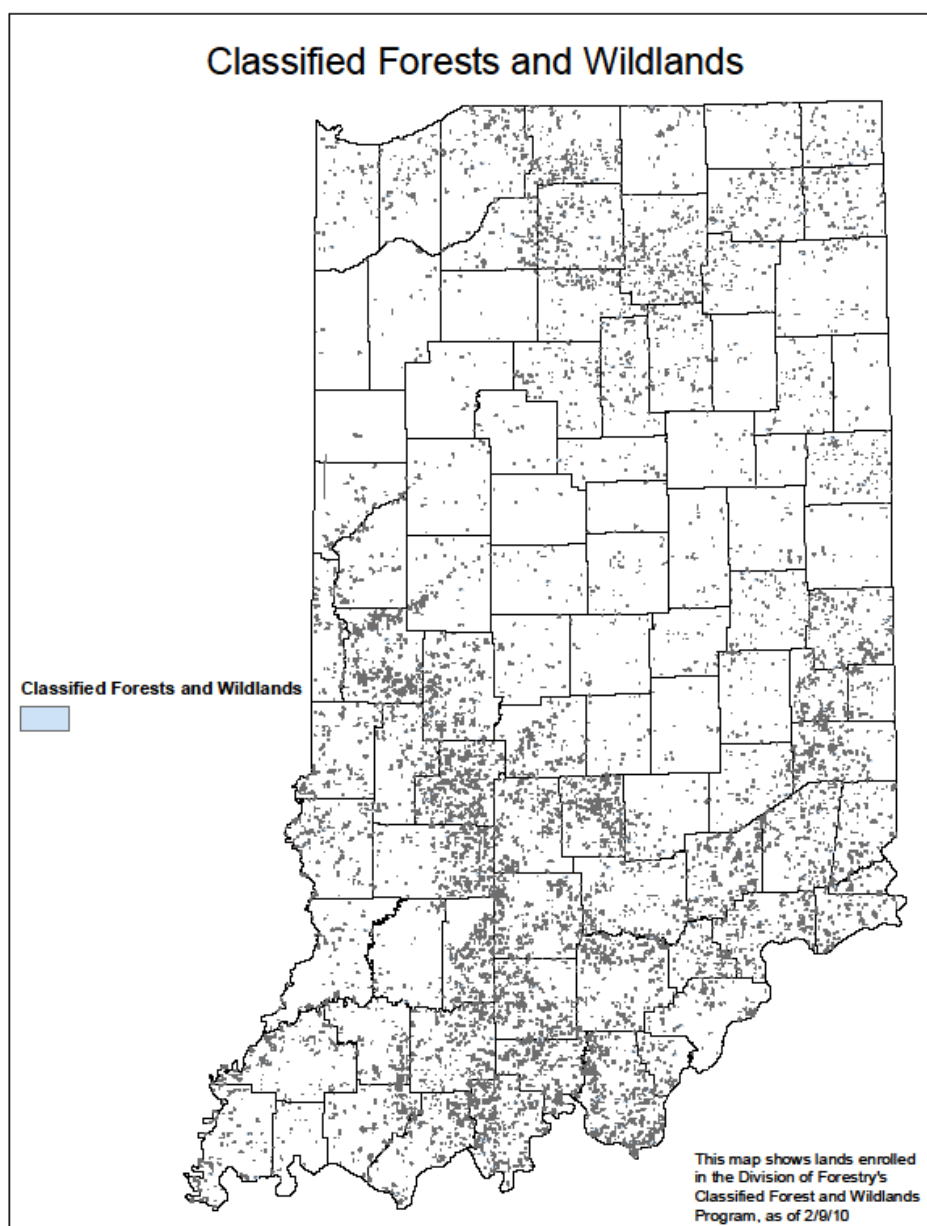
Classified forests

The Classified Forest and Wildlands is a highly successful program initiated in 1921 by the State of Indiana under the leadership of Charles C. Deam, Indiana's first State Forester. It encourages timber production, watershed protection, and wildlife habitat management on private lands in Indiana. Program landowners receive a property tax reduction in return for following a professionally written management plan.

This program is open to enrollment year-round by contacting a local State District Forester:

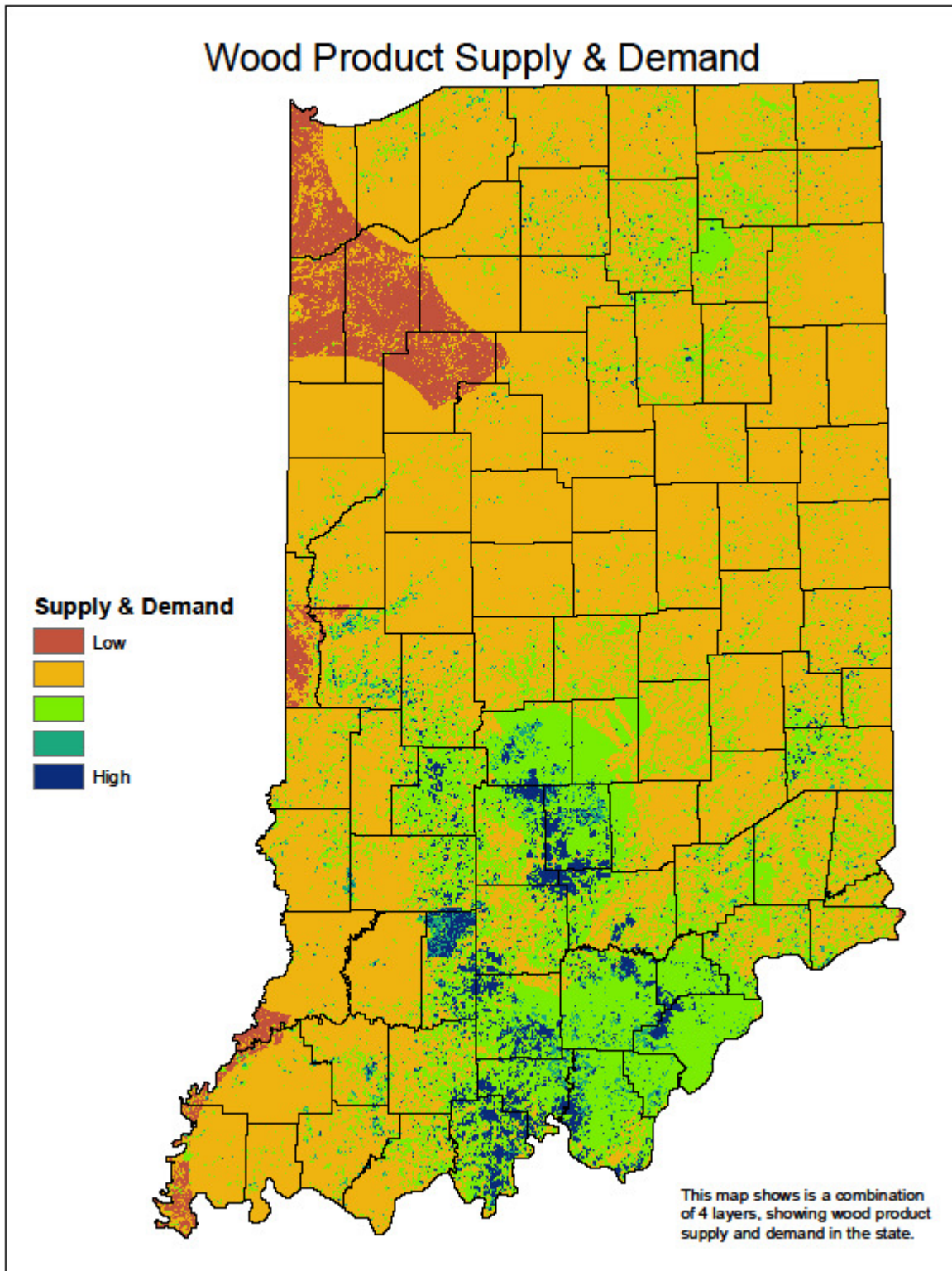
http://www.in.gov/dnr/forestry/files/fo-District_forester_list_print_version.pdf

There are currently about 648,000 acres enrolled as Classified Forests and Wildlands representing approximately 10.7% of forests in Indiana. These private properties reflect a commitment to the retention of forestland and the maintenance of sustainable working woodlands. These properties are a major supplier of timber for the State's wood product needs. It is estimated that these properties annually harvest 35 million board feet of timber. (IDNR, 2009)



Priority Landscape Areas: Wood Products

This map shows the prioritized importance of forestlands associated with the economic value of timber production and the recognized forest issue - sustaining Indiana's forest products industry. This map should be used by conservation and landscape stewardship partners, whose efforts focus on working woodlands, keeping forests as forests or aspects of rural development.



Other issues

This section includes some supplementary geospatial information that is not of comparable resolution and includes data sets that were not used in Priority Landscape Analysis. Forests issues that are not covered in this or the above section were unable to be addressed in a geospatial context or carried a statewide importance factor that fell outside the scope of this document. Further information about all recognized forest issues can be found in Appendix D.

High cost of forest ownership and low incentives to retain

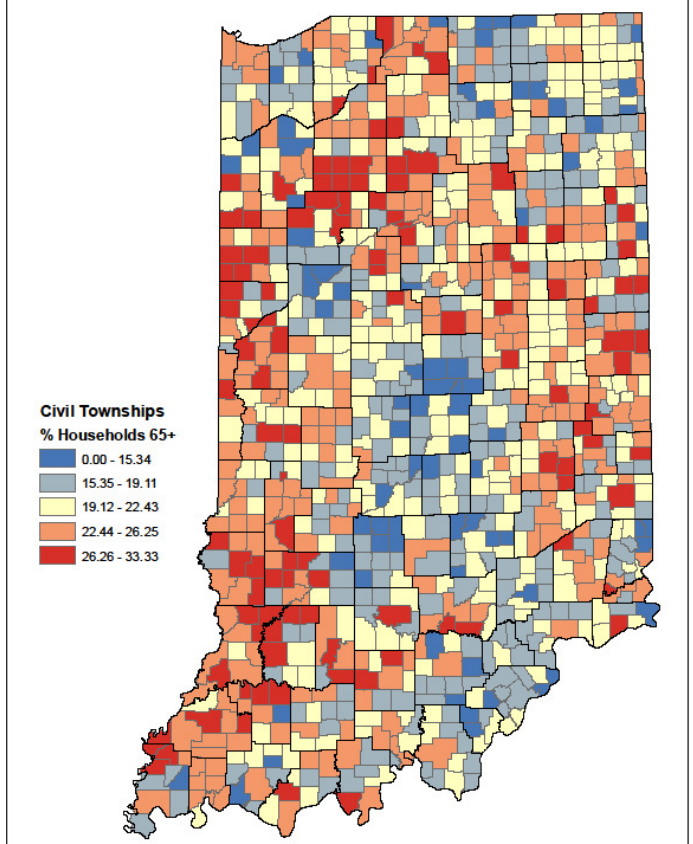
This issue is reflective of a number of identified data gaps (See Appendix B). Costs of forest ownership can be substantial, especially when faced with management costs associated with invasive species. Forest establishment, seedling purchase, weed management, boundary marking, timber stand improvement, invasive control, access road planning, harvest costs, property tax, severance tax and estate tax can all play a part among other things and depending on the condition of the forest land considered, in determining the cash outflow relating to forest property ownership.

As discussed in the Wood Products section above, in Indiana the main and most significant economic value associate with woodland ownership is derived from the management and harvest of timber. Currently, there are a number of other potential revenue streams associated with forestland, like maple syrup production, forest herbs and fruit, and hunting leases but none of these compare with associated timber values.

There are efforts underway to provide additional economic value streams to forestland owners that compensate for other ecosystem services that are currently not assigned an economic value. A leader in this effort is the USDA's Office of Environmental Markets. The Office of Environmental Markets is supporting the development of emerging markets for carbon, water quality, wetlands and biodiversity.

This issue recognizes a gap between costs and income from forest ownership and this can be particularly relevant to persons who are retired or on fixed income. This map (see above) details a demographic by County Township for whom this issue may be particularly relevant. Demographic patterns in forest ownership can have particular influence when there are transfers of ownership. Oftentimes, properties are divided at this time and estate tax assessments influence the remaining property structure, goals and forest quality.

Percent of Households with a Person 65 Years or Older



Over population of Whitetailed deer

The over population of Whitetailed deer is an important issue for many forest stakeholders. The overriding concern is the preservation and maintenance of a diverse and healthy native understory of trees and vegetation that will in succeeding generations determine the composition of the dominant canopy. An overpopulation of deer will limit the biological diversity of an area, denude the understory of choice forage, like oak seedlings, and favor a population of generally unpalatable exotic invasives.

Deer are also a particular concern for those landowners planting and establishing seedlings in forest regeneration or orchard settings. Next to weed pressure, deer browse can be the major factor determining success or failure in these efforts.

Whitetailed deer are managed by the IDNR and their populations are controlled mainly by seasonal hunting. Population estimates and high resolution density data were not provided by the IDNR. An unequal but available proxy is provided in the map (at right) that shows the locations of the over 16,000 deer collisions recorded by State Police in 2008.



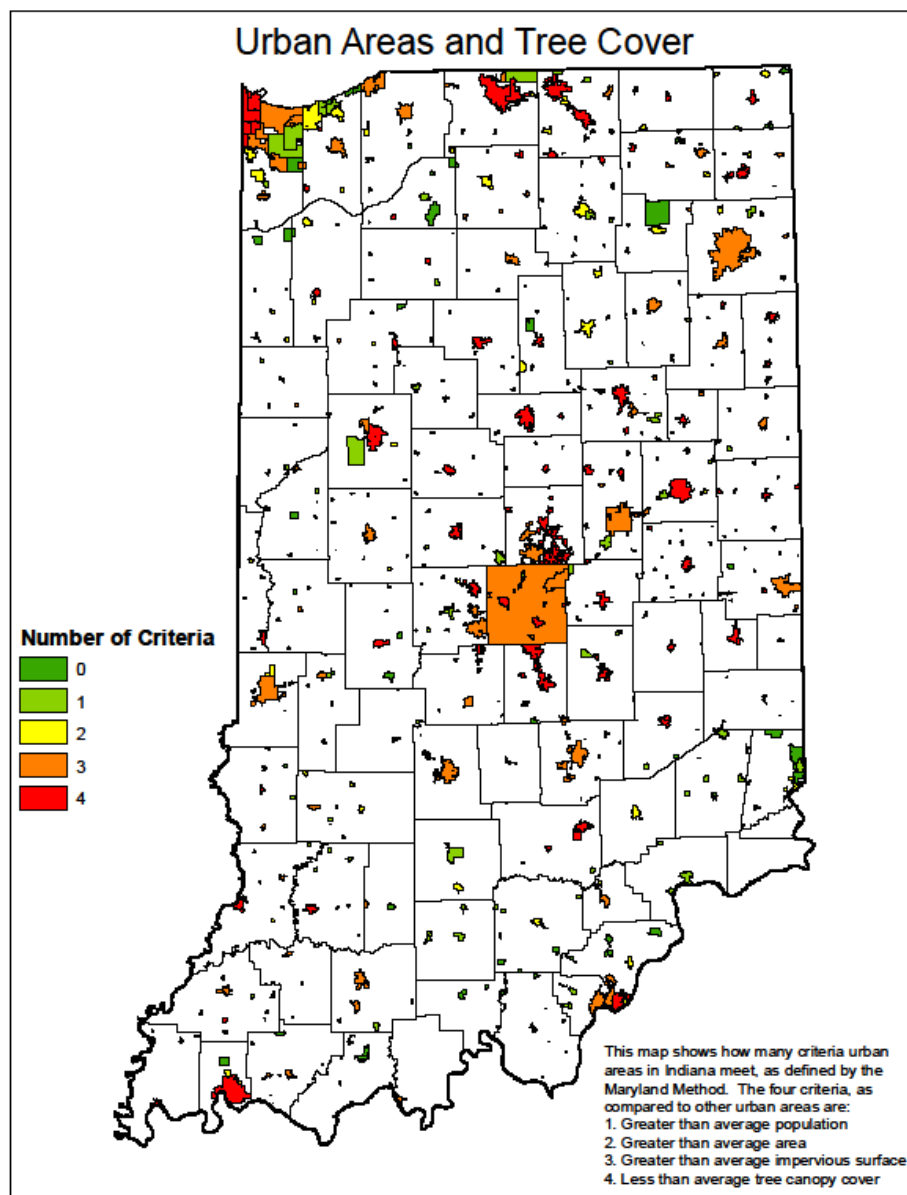
IDNR Division of Parks and Recreation is exempted from statewide hunting season controls on population and manages park deer herds based on environmental browse and enclosure surveys among other information that then inform controlled hunts on properties. These environmental browse and enclosure surveys are not conducted on a statewide basis to provide information on the ecological impact of current deer populations.

Urban Forests

The map below shows how many urban areas meet the following criteria: greater than average population, greater than average area, greater than average impervious surface and less than average tree canopy cover. This is a statewide dataset that reflects the potential for benefit from increased tree cover among Indiana's urban communities.

Canopy cover is a very important component of the urban forest. Leaf surface area directly correlates with the benefits of street trees. The greater the leaf surface area exhibited by a tree, the greater the benefits a particular tree is likely to provide to a community. Trees with large leaves and spreading canopies tend to produce the most benefits.

Street trees and urban forests provide ecological services that include 1) reduced air pollution, 2) storm-water control, 3) carbon storage, 4) improved water quality, and 5) reduced energy consumption. Other, harder to quantify benefits include increased job satisfaction, faster recovery time for hospital patients, and improved child development among other things. Also, aesthetic values associated with increased urban canopy contribute to higher property values. (Kane, 2009)



Priority Landscape Areas

The above section of the Assessment presents geospatial information on a number of recognized forest issues. Based on relative importance, the majority of the most pressing issues are presented with a number of component maps that contribute to topic understanding. The issues that are presented above with corresponding Priority Landscape Areas analysis are:

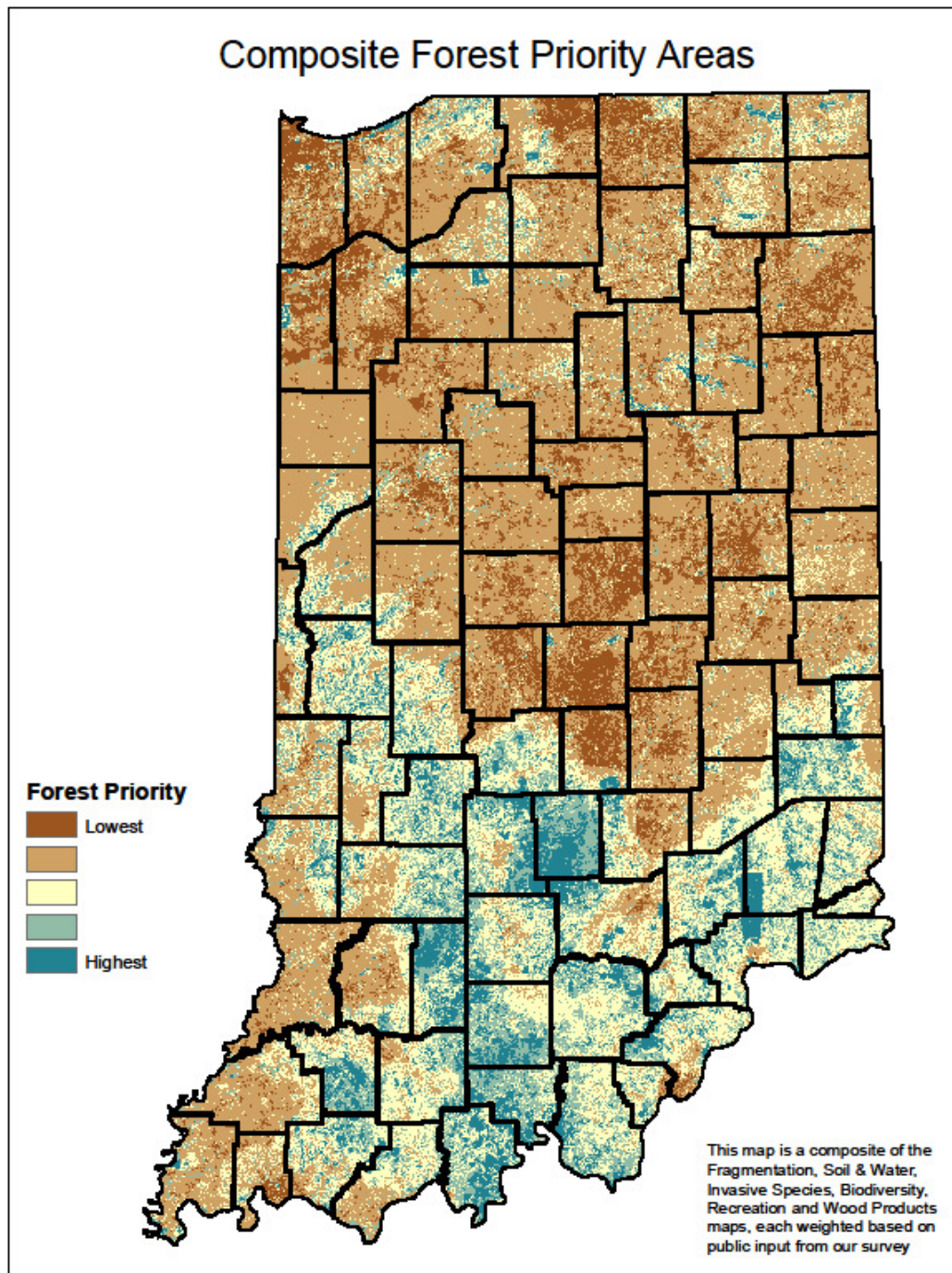
<u>Indiana Forest Issue</u>	<u>Relative Importance Score</u>
Fragmentation and/or conversion of forests to another land use	507
Conservation and maintenance of soil and water resources	425
The spread and control of invasive species	421
Conservation of biodiversity	364
Availability of land for public recreation	234
Conservation of forests that protect drinking water supplies	206
Sustaining Indiana's forest product industry	160

To create the required composite statewide composite map, issue maps are weighted following a 2009 Survey determined scale: Fragmentation 24%, Soil & Water 20%, Invasives 20%, Biodiversity 17%, Recreation 11% and Industry 8%. This methodology is more fully described in Appendix A.

Again, these percentage weights are derived from 2009 Survey responses where stakeholders ranked the three most important issues facing Indiana's forests. This prioritization and reflection of relative importance coincides with the stated goals of the required Priority Landscape Areas analysis.

Indiana – composite map

It is a federally required element that the Assessment identifies landscape areas where national, regional, and state resource issues and priorities converge. This is described further in S&PF national guidance: priority landscape areas will help “to ensure that federal and state resources are being focused on important landscape areas with the greatest opportunity to address shared management priorities and achieve measurable outcomes.” In brief, these statements reflect the fact that there are limited state and federal funds and there is a desire that these funds be spent in a manner that they produce greatest benefit.



Multi-state

[This section has not been edited.]

These areas represent existing and potential multi-state forestry related efforts and partnerships that involve Indiana.

Area

- Great Lakes regional collaborative - water pollution, loss of migratory bird habitat, forest loss and fragmentation, climate change, Lake Superior Tributaries
- Ohio River Corridor - Significant water quality issues, many potential partners
- Chicago/ Gary, IL - Chicago Wilderness - emphasis on urban areas that transcend state lines.
- Fire Compact - Big Rivers
- Toledo Urban Area
- Wabash River valley
- Missouri River corridor
- Karst areas
- Oak Regeneration - oak regeneration, impacts from deer browse, turkey
- Hardwood Region - Indiana Bat conservation
- Western mid-Atlantic development - major interstate highway corridors, parcelization, significant urban forest management issues
- Interstate Highway Corridors - vectors for movement of invasive species & development, lack of canopy cover.
- Multistate Watersheds Plans - St. Joseph River Watershed Management Plan
- Multistate Fish Habitat Restoration Strategy
- National Fish Habitat Action Plan Partnerships
- Upper Midwest and Great Lakes Landscape Conservation Cooperative - landscape scale conservation for identified species or groups of species.
- Bird Conservation Joint Ventures - partners assistance with implementing national and international bird habitat conservation plans. Joint Ventures started with a focus on waterfowl and have broadened to all bird species.

Issues

- Invasive species (insects and plants), e.g., spread of Emerald Ash Borer and Asian Longhorned Beetle; work with Cooperative Weed Management Areas for addressing invasive plants.

Region (existing)

- Great Lakes regional collaborative
- Ohio River Corridor
- Fire Compact - Big Rivers

Region (existing)

- Toledo Urban Area
- Wabash River valley
- Karst areas
- Hardwood Region
- Chicago/ Gary, IL - Chicago Wilderness

Coordination with Groups and Other Plans

This section details the efforts to develop this Assessment, coordinate with stakeholder groups and individuals and encourage the widest possible participation.

The Division of Forestry has consulted with key stakeholders to ensure that the State Assessment (1) integrates, builds upon, and complements other state natural resource assessments and plans and (2) identifies opportunities for program coordination and integration.

Stakeholder Involvement

The Forest Stewardship Coordinating Committee, an established group representing a range of forestry interests in the state, has participated in the stakeholder process along with, State wildlife agency, State Technical Committee, and applicable federal land management representatives.

A wide and diverse group of stakeholders and individuals that have an identified interest in forestry or forestland use was surveyed and invited to participate in the Indiana Forest Stakeholder Summit that occurred in June and July of 2009.

The Indiana Forest Stakeholder Summit was held at 4 regional Indiana locations between June 24 and July 2, 2009 – Wabash in the north, Indianapolis in the central region, Bloomington in the south central region and Huntingburg in the south.

The Summit provided forest stakeholders with an opportunity to provide input, suggestions and comments relating to the development of Indiana's Statewide Forest Assessment. The Summit attempted to refine and clarify the most pressing issues that are being faced by Indiana's private, public and urban forests. Stakeholders also contributed their visions of a desired future forest condition and discussed the implications of priority landscape areas.

The Indiana Forest Stakeholder Summit was successful in bringing together and engaging a wide range of forestry interests and enabling them to share their concerns for the condition and future of our diverse Indiana woodlands.

A detailed list of the groups that participated in the 2009 Assessment related survey and summit as well as the names of individuals who reviewed the initial draft of this document can be found in Appendix F.

Document Review Process

[To be added following review.]

Appendix A: Priority Landscape Areas Methodology

[This section has not been edited.]

Forest land in Indiana comes from the 2009 National Agricultural Statistics Survey (NASS) satellite imagery. Classes 141 (Deciduous Forest), 142 (Evergreen Forest), 143 (Mixed Forest), 152 (Shrubland), and 190 (Woody Wetlands) were reclassified to forest, and all other classes were grouped as “other”. Then, using cost share boundaries from the USDA Farm Services Agency (FSA), cropland was erased from the forest reclassification to remove any mixed or misclassified pixels. Finally, all interstates, U.S. highways, and state highways were buffered by 15 meters per side (creating a minimum width of 1 pixel for roads) and were also erased from the forest coverage, again to remove mixed or misclassified pixels. This layer was used in many other component maps.

Forest patches were derived from 2009 NASS data reclassified into forest and other, with state, U.S. and interstate highways erased. Acreage was then calculated for each contiguous patch.

Limited Conversion lands was created by selecting out all public lands and private lands with conservation easements from the DNR Managed Lands database, along with all Nature Conservancy and Sycamore Land Trust properties.

Impaired waters by watershed was created by taking 303d streams from the 2008 impaired stream dataset maintained by the Indiana Department of Environmental Management (IDEM), intersecting that layer with 10 digit watershed boundaries, and then comparing the length of impaired streams and water body boundaries per watershed to the total length of streams and water body boundaries per watershed, using the high-resolution national Hydrography dataset (NHD).

Our invasive species map was created using known kudzu points, emerald ash borer (EAB) quarantined townships, and all areas of the state north and east of the 10 moth catch line interpolated from gypsy moth traps.

The 3K, 5K, and 10K maps were all created using the same methodology, with differing radii. First, using 2007 NASS satellite imagery, forest land was selected. Classes 141 (Deciduous Forest), 142 (Evergreen Forest), 143 (Mixed Forest), 152 (Shrubland), and 190 (Woody Wetlands) were used to define forest, with all other classes grouped as “other”. Focal statistics were then used to look at a circle around each point, at 3, 5, and 10k radii to determine the percent forest cover. For the final draft of the assessment, these layers will be updated by using the 2009 NASS forest dataset. These datasets can be used both to show where there is a high density of forest and where there is a high amount of forest fragmentation.

Population change by county came from U.S. census data.

Soil erodibility comes from the K factor of the Natural Resource Conservation Service (NRCS) STATSGO soils, and can be used as a means of finding highly erosive soils which should have trees or some other perpetual ground cover to prevent soil loss.

Deer collision data comes from GPS locations where Indiana State Police responded to deer/vehicle collisions in Indiana in 2008. This layer is a rough proxy for deer population distribution throughout Indiana.

Forested riparian areas was created by buffering all perennial water bodies by 300 feet (per side for streams and rivers), and clipping the forest land layer to the buffered area. Both the buffer and the forest land layer were then intersected with 10 digit watersheds, and the percent of forest in buffered riparian areas by watershed was calculated.

Forest by watershed was calculated by intersecting the forest land layer with 10 digit watershed, and calculating the amount of forest in each watershed.

Impervious surfaces were calculated by reclassifying the 2009 NASS imagery. Classes 121-124 (Developed/Open Space, Developed/Low Intensity, Developed/Medium Intensity and Developed/High Intensity) were reclassified to urban, and everything else was grouped as "other". The amount of urban land in each 10 digit watershed was then calculated. Using the estimate of ~24% of urban land being impervious, the urban areas were then multiplied by .24 to determine the amount of impervious surface in each 10 digit watershed, which gives an idea of water quality within each watershed.

Appendix B: List of Data Gaps

These data gaps are discussed in the above text and keenly relevant to the forest issues of recognized importance. Unless otherwise aggregated, high resolution data is 30 meter square pixels statewide.

- All county parcel data (65/92 currently providing GIS data with the State of Indiana)
- Tax rates
- Statewide zoning restrictions
- Forestland sale prices by parcel or at least township
- Perennial vs. annual agricultural vegetative cover
- Comprehensive state-level surveys for invasive species
- Stand age and forest type
- Understory and midstory survey – oak distribution
- Forest biodiversity connectivity and dispersal corridors
- Productive capacity (site index)
- Active management of forests, especially timber harvests
- Forest ownership demographics
- Estate tax income from properties greater than 10 acres
- Ecological impact of deer herbivory survey

Appendix C: References

[This section has not been edited.]

- Donovan, T. M., P. W. Jones, E. M. Annand, and F. R. Thompson, III. 1997. Variation in local-scale effects: mechanisms and landscape context. *Ecology*, 78(7): 2064-2075.
- Duchamp, J. E., and R. K. Swihart. 2008. Shifts in bat community structure related to evolved traits and features of human-altered landscapes. *Landscape Ecology*, 23:849-860.
- Hartley, M. J., and M. L. Hunter. 1998. A meta-analysis of forest cover, edge effects, and artificial nest predation rates. *Conservation Biology*, 12(2):465-469.
- Hermann, H. L., K. J. Babbitt, M. J. Baber, and R. G. Congalton. 2005. Effects of landscape characteristics on amphibian distribution in a forest-dominated landscape. *Biological Conservation*, 123:139-149.
- Knutson, M. G., J. R. Sauer, D. A. Olsen, M. J. Mossman, L. M. Hemesath, and M. J. Lannoo. 1999. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin. *Conservation Biology*, 13(6):1437-1446.
- Thompson, F. R., III, T. M. Donovan, R. M. DeGraaf, J. Faaborg, and S. K. Robinson. 2002. A multi-scale perspective of the effects of forest fragmentation on birds in eastern forests. Pages 8-19 *in* T. L. George and D. S. Dobkin, eds., *Effects of habitat fragmentation on birds in western landscapes: contrasts with paradigms from the eastern United States*. *Studies in Avian Biology*, 25.
- Trzcinski, M. K., L. Fahrig, and G. Merriam. 1999. Independent effects of forest cover and fragmentation on the distribution of forest breeding birds. *Ecological Applications*, 9(2):586-593.

Appendix D: Glossary & Index (with links to external information)

[This section is to be appended, revised and edited. Please provide valuable links and information.]

BMP – Best Management Practices for harvesting timber and preserving soil and water quality.
[Insert web link]

Biodiversity –

Indiana Biodiversity Initiative

<http://www.indiana.edu/~spea/faculty/meretsky-vickyj.shtml>

Lepidopteran Use of Native & Alien Ornamental Plants

<http://copland.udel.edu/~dtallamy/host/>

Indiana Comprehensive Wildlife Strategy

<http://www.wildlifeactionplans.org/indiana.html>

Fragmentation –

Wikipedia - Forest Fragmentation

http://en.wikipedia.org/wiki/Forest_fragmentation

US Forest Service - Fragmentation and Land Use Change

http://www.nrs.fs.fed.us/disturbance/land_use_fragmentation/

Birds in Forested Landscapes – Cornell Lab of Ornithology

http://www.birds.cornell.edu/bfl/gen_instructions/fragmentation.html

Purdue Land use Tam

<http://www.ces.purdue.edu/anr/landuse/>

GIS – Geographic Information System - is any system that captures, stores, analyzes, manages, and presents data that are linked to location.

IDNR – Indiana Department of Natural Resources

<http://www.in.gov/dnr/>

Invasive Species –

Indiana Invasive Species Task Force & Invasive Plant Species Assessment Working Group (IPSAWG) - <http://www.in.gov/dnr/3123.htm>

Indiana Cooperative Agricultural Pest Survey (CAPS)

<http://extension.entm.purdue.edu/CAPS/>

Indiana Native Plant and Wildflower Society

<http://www.inpaws.org/>

Indiana's Natural Heritage - <http://www.naturalheritageofindiana.org/>

NRCS – Natural Resource Conservation Service

[Insert web link]

Recreation –

Indiana SCORP

<http://www.in.gov/dnr/outdoor/files/06scorpintro.pdf>

Soil & Water –

Indiana Department of Environmental Management

<http://www.in.gov/idem/>

S&PF – State and Private Forestry, section of United States Forest Service

<http://www.fs.fed.us/spf/>

Statewide Forest Resource Strategy 2010 – It is a federally required document that that will be submitted to the USDA Forest Service, signed by the State Forester, by June 18, 2010. Elements of the State Assessment and Strategy are required by the Federal Farm Bill for the Division of Forestry to continue receiving funds under the Cooperative Forestry Assistance Act.

USFS – United States Forest Service

<http://www.fs.fed.us/>

Wood Products -

Indiana's Hardwood Industry: It's Economic Impact

http://www.in.gov/dnr/forestry/files/fo-IHI_economic-impact.pdf

Premium Indiana Forest Products

<http://www.indianawoodisgood.org/>

The Sustainability of Indiana's Forest Resources

<http://www.in.gov/dnr/forestry/files/fo-SIFR%28lowres%29.pdf>

Sustainable Forestry Initiative

<http://www.sfiprogram.org/>

Forest Stewardship Council

<http://www.fsc.org/>

Indiana State Department of Agriculture's Strategic Plan

<http://www.in.gov/isda/2539.htm>

Primary and Secondary Forest Products Industry Directory

http://www.state.in.us/dnr/dnr_forest/index.html

Appendix E: How the Assessment Addresses the National Themes

[This section is to assist federal agencies in reviewing the document and will be provided in the final draft.]

Appendix F: Contributing stakeholder groups

[This section has not been edited.]

Beyond those groups mentioned in the Introduction and Acknowledgements section over 300 organizations contributed to the development of this document:

A&A Township Volunteer Fire Dept.
ACRES Land Trust
Adventure Media
Alliance for Community Trees
American Chestnut Foundation of Indiana
American Fisheries Society
American Legion
American Motorcycle Association
American Planning Association, Indiana Chapter
American Society of Consulting Arborists
American Society of Quality Control
American tree Farm System
Arbor Day Foundation
Arbor Day Society
Arbutus Garden Club
Arnold Arboretum
Arrow Head Country RC&D
Association of Consulting Foresters
Audubon Society
Avant-Gardens Development LLC
Avon Outdoor Learning Center
Baugo Township Fire Department
Bloomington Parks and Recreation
Bloomington Permaculture Guild
Blue Ribbon Coalition
BOD ACRES Land Trust
Boonville Fire Department
Bradford Woods of Indiana University
Brooklyn Volunteer Fire Department
Brown County Native Woodlands Project
Brown County SWCD
Cardinal Greenway, Inc.
Cass County Soil & Water Conservation District
Center for Earth and Environmental Science, IUPUI
Central Indiana Land Trust
Chain O' Lakes Gun Club Inc.
City of Bloomington Fire Department
City of Carmel
City of Gary - Environmental Affairs
City of Goshen, Goshen Parks and Rec. Department
City of Indianapolis Tree Board
City of Michigan City
City of South Bend Parks
Clark County Soil and Water Conservation District

Clarksburg Volunteer Fire Department
Clay County Soil & Water Conservation District
Clifty/ Flatrock-Haw Creek Watershed Project
Cole Hardwood, Inc.
Columbia City Tree Board
Covington Community Schools
Crawford County Concerned Citizens
Crawfordsville Fire Dept
Cree Lake Conservation Club
Culver Tree Commission
Cycle Conservation Club
Daviess-Martin Joint County Parks & Recreation Dept.
Dearborn County Soil and Water Conservation District
Delaware County Soil and Water Conservation District
Delta Waterfowl
DePauw University
Discover Indiana Riding Trails Inc.
Dubois Co. Sportsmen's Club
Dubois Co. SWCD
Dubois County Farm Bureau
Dubois County Soil and Water Conservation District
Dubois County Sportsmen's Club
Ducks Unlimited
Dudley Farm Partnership
Eco Logic LLC
Elders for Earth's Future
Elkhart Co SWCD
Elkhart County Parks
Elkhart County Soil and Water Conservation District
Elutherian College
English Fire Department
Environmental Education Association of Indiana
Evansville Smart Growth Committee,
Evansville Tree Advisory Board
Farmers and Hunters Feeding the Hungry
Faulkenberg Printing Co.
Fayette County Health Department
Ferdinand Chamber of Commerce
Fernwood Botanical Gardens
Fire Department of Rossville, Indiana
Forest Resource Planning
Francesville Fire Department
Fremont Fire Department
Friends of Sugar Creek
Friends of the Limberlost
Grant County Area Plan Commission
Greencastle Civic League
Greenpeace
Greenwood Parks and Recreation
Groundwork Gary
Hamilton County SWCD

Hancock County SWDC
Hardwood Federation
Hardwood Forestry Fund
Harrison County Conservation Committee
Heartwood
Hendricks County Government
HHH Woodland Resource
Hoosier Association of Science Teachers Inc
Hoosier Energy
Hoosier Environmental Council
Hoosier Heartland RC & D
Hoosier Hikers Council
Hoosier National Forest
Hoosier Sierra Club
Hoosier State Press Association
Hoosier Trail Riders
IDNR - Division of Fish and Wildlife
IDNR - Division of Fish and Wildlife, Fisheries Section
IDNR - Division of Forestry
IDNR - Division of Nature Preserves
IDNR - Division of Outdoor Recreation
IDNR - Division of Parks and Reservoirs
Indiana Arborist Association
Indiana Arborist Society
Indiana Association of Biology Teachers
Indiana Association of Consulting Foresters
Indiana Association of Soil and Water Conservation Districts
Indiana Audubon Society, Inc
Indiana Bow hunters Association
Indiana Chapter of the Ruffed Grouse Society
Indiana Deer Hunters Association
Indiana Department of Transportation
Indiana Design Consortium, Inc.
Indiana Farm Bureau
Indiana Farm Mangers & Rural Appraisers
Indiana Fire Chiefs Association
Indiana Forest Alliance
Indiana Forest Industry Council
Indiana Forestry & Woodland Owners Association
Indiana Green Party
Indiana Hardwood Lumberman's Association
Indiana Hunter Education Association
Indiana Karst Conservancy
Indiana Land Protection Alliance
Indiana Native Plant and Woodland Society
Indiana Outdoor News
Indiana Park and Recreation Association
Indiana Planning Association; Nature Conservancy
Indiana Rural Community Assistance Program
Indiana Society of American Foresters
Indiana State Department of Agriculture

Indiana University
Indiana Urban Forest Council
Indiana Urban Forest Council
Indiana Walnut Council
Indiana Wildlife Federation
Indianapolis, Marion County Tree Board
Indy Parks and Recreation
International Society of Arboriculture
Izaak Walton League
Izaak Walton League Evansville Chapter
Jackson County Historical Society
Jefferson county BZA
Jefferson Township Fire Department
JFNew Inc.
Keep Indianapolis Beautiful
Kiwanis
Knox County SWCD
Koetter & Smith, Inc.
Kosciusko Co. SWCD
La Porte County Conservation Trust, Inc.
LaGrange County SWCD
Lake Michigan Coastal Advisory Board
Lanesville, Franklin Township VFD
LaOtto Fire Department
LaPorte County Conservation Trust, Inc.
LaPorte County Soil and Water Conservation District
Last Chance, LLC
League of Women Voters
Limberlost Conservation Assn Inc. Town tree board
Lincoln Hills RC&D
Lincoln Hills RC&D
Little River Wetlands Project, Inc
Loogootee Vol. Fire Department
Madison Township VFD, Dubois County
Maley & Wertz, Inc.
Marion County SWCD
MARRS Township VFD
Marshall Township Planning Commission
Martinsville High school
Merry Lea Environmental Learning Center of Goshen College
Michigan Forest Association
Millbrook HOA
Monroe County Parks and Recreation
Monroe County Planning
Mooresville Fire Department
Moraine Forest Partners
Moraine Ridge Wildlife Rehabilitation Center
National Arbor Society
National Rifle Association
National Speleological Society
National Tree Farm System

National Wild Turkey Federation
Nature Conservancy
New Carlisle Fire Dept
NICHES Land Trust
Noble County Soil & Water Conservation District
Noble County Whitetails
North American Hunting Club
Northwestern Indiana Regional Planning Commission
Oak Heritage Conservancy
Outdoor Sportsman's Club of Mitchell
Owl Creek Programs
Pheasants Forever
Pike Lumber Company Inc.
Posey County Soil & Water Cons. Assoc.
Professional Bow hunters Society
Protect Our Woods
Purdue Extension
Purdue University, Department of Forestry and Natural Resources
Quabache land Conservancy
Quail Unlimited
Quality Deer Management Association
Readings by Natalie
Red-tail Conservancy
Regional Biologist-NWTF
Rensselaer Urban Forestry Council
Riley Fire Department, Indiana Fire Chief's Assn
Rockport-Ohio Twp Fire Department,
Rocky Mountain Elk Foundation
Ruffed Grouse Society
Safari Club International
Salem Township Fire Dept
Save the Dunes Conservation Fund
Scott County Soil & Water Conservation District
Shirley Heinze Land Trust, Inc.
Sierra Club of Indiana
Sierra Club - Winding Waters Group
Society for Ecological Restoration
Society of American Foresters
Society of Municipal Arborists
South Loughery Creek Watershed
South Loughery Watershed Project
Southern Indiana Cooperative Weed Management Area
Southwest Central Fire Territory
Spencer County Soil and Water Conservation District
St. Joseph County Soil and Water Conservation District
St. Joseph Valley Beagle Club, Inc.
St. Paul VFD
State Soil Conservation Board
Steuben County Soil and Water
Sunman Rural Fire Department
Switz City Volunteer Fire Dept.

Switzerland County SWCD
Sycamore Land Trust
Sycamore Trails RC&D
Taylor University
The Carmel Urban Forest Committee
The Humane Farming Action Fund
The Natural Resource Defense Council
The Nature Conservancy
The Oxford Society
The Ruffed Grouse Society
The Whistler Foundation
The Wildlife Society
Tippecanoe Audubon Society
Tippecanoe County Soil & Water Conservation District
Tipton Tree Advisory Committee
Town of Ingalls
Town of Russiaville
Transition Bloomington
Trillium Land Conservancy
Trust for Public Lands
U.S. Office of Surface Mining
Union County SWCD
Union of Concerned Scientists
University of Illinois
US Green Building Coalition
USDA Forest Service
USDA Natural Resource Conservation Service
Valley Watch, Inc.
Valpo Chain of Lakes
Van Buren Fire Dept.
Vincennes University, Jasper Campus
Vine & Branch, Inc.
Volunteer Fire Department
Wabash River Heritage Corridor Commission
Walnut Council & Virginia Forestry Association
Walnut Growers of Indiana
Ward Township VFD
Washington Conservation Club
Washington Twp Fire Department
Wayne County SWCD
Wells Fargo Bank
Wesselman Nature Society Board
Wheatfield Vol. Fire Dept Inc.
White River and Lincoln Hills RC&D
Wild Turkey Association
Wildlife Society
Willow Slough Fish and Wildlife Area
Winamac Tree Committee
Wisconsin Woodland Owners Association
Woodland Steward Institute
Wood-Land-Lakes RC&D

Appendix G: Additional Maps

Lindsey's Presettlement Vegetation Types

This map defines vegetation types that existed at the time of European expansion into Indiana and helps understand historical landscapes. It should be noted that large areas that were previously wetlands have altered hydrology and have mainly been drained using agricultural tile to promote conditions amenable to row crop commodity agricultural production.

Natural Divisions of Indiana with Presettlement Vegetation Types

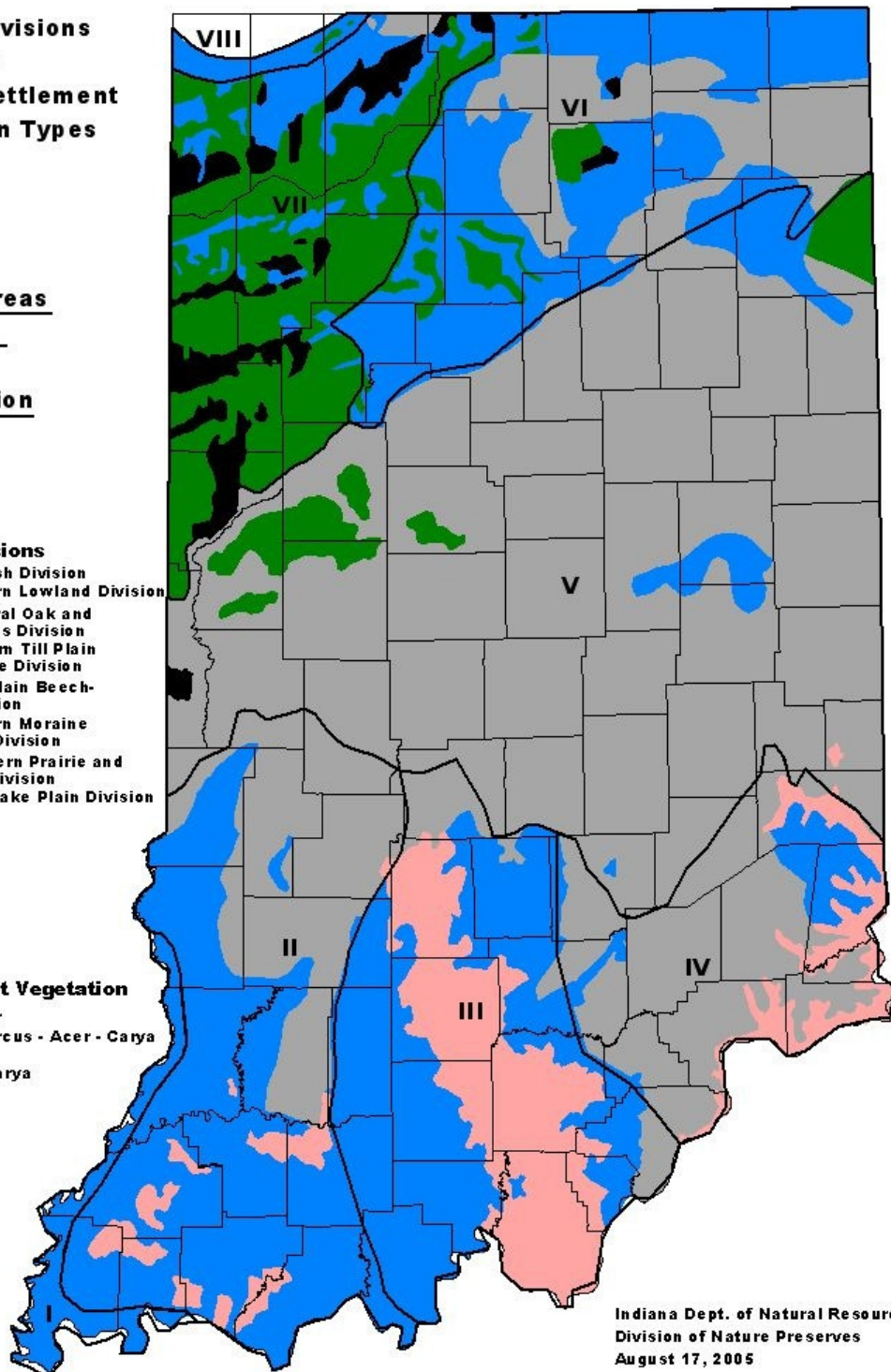
from
**Lindsey,
Natural Areas
in Indiana
and Their
Preservation**

Natural Divisions

- I. Lower Wabash Division
- II. Southwestern Lowland Division
- III. South-central Oak and Mixed Woods Division
- IV. Southeastern Till Plain Beech-Maple Division
- V. Tipton Till Plain Beech-Maple Division
- VI. Northeastern Moraine and Kettle Division
- VII. Northwestern Prairie and Wetlands Division
- VIII. Calumet Lake Plain Division

Presettlement Vegetation

- Fagus - Acer
- Fagus - Quercus - Acer - Carya
- Prairie
- Quercus - Carya
- Wetlands

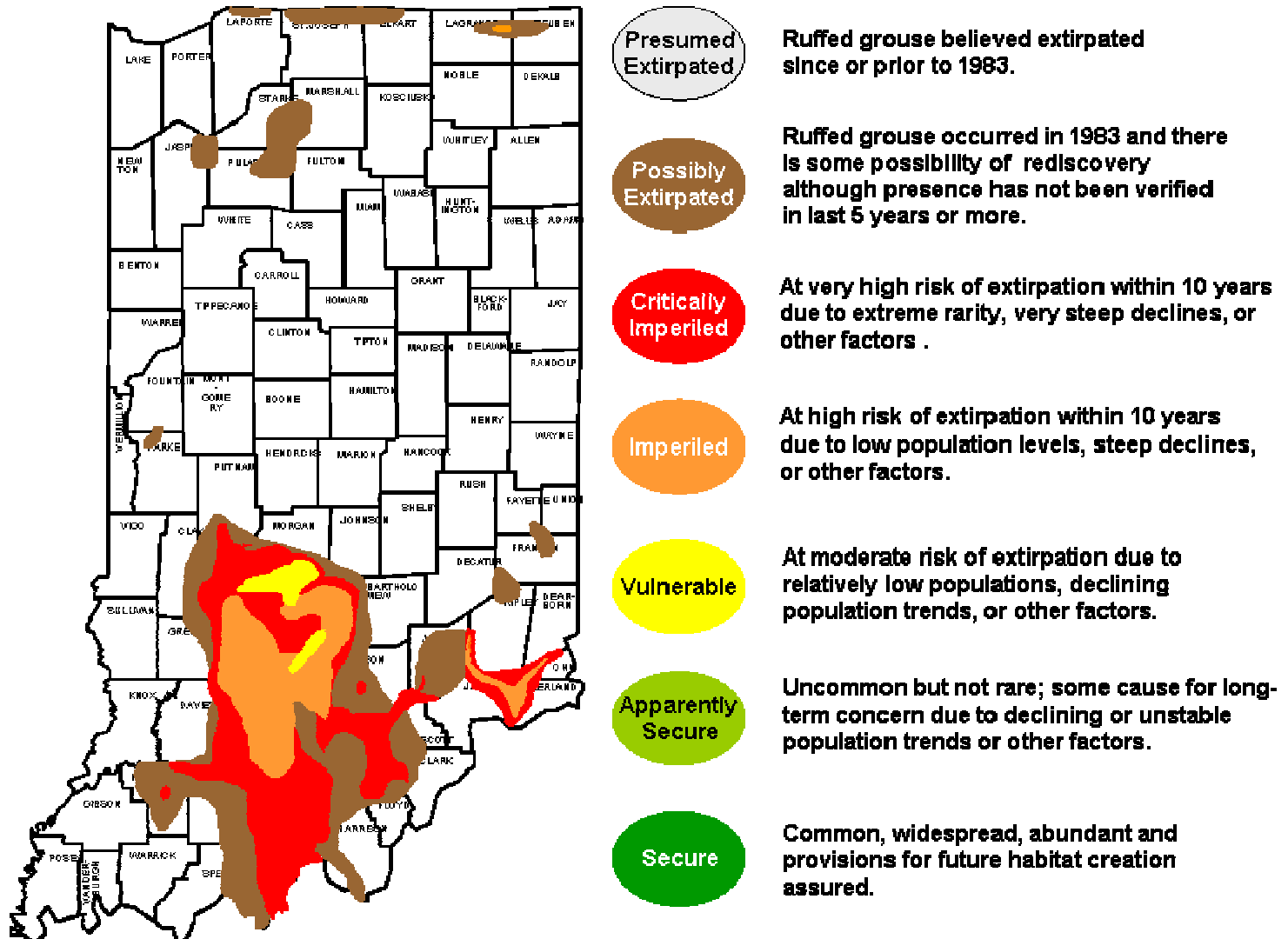


Indiana Dept. of Natural Resources
Division of Nature Preserves
August 17, 2005

Ruffed Grouse Distribution

This information should be considered supplementary to relevant discussions in the Biodiversity section above.

“The distribution of ruffed grouse (*Bonasa umbellus*) in Indiana has historically fluctuated with changing land use. In 1931, ruffed grouse occurred in only 12 counties. Following reforestation, natural range expansion and successful restoration efforts, the grouse distribution expanded to 41 counties in 1983, the widest distribution since 1856. A reassessment of grouse distribution in Indiana was initiated in 2008 using reports of ruffed grouse made during the last 5 years. Compared to the 1983 distribution, it is highly probable that ruffed grouse are now extirpated from 15 counties and likely to exceed 25 counties within a few years if no major forest disturbance occurs. Preliminary data from the Indiana Breeding Bird Atlas (2005-2010) indicate ruffed grouse occurred in less than 1% of the priority blocks surveyed compared to 10% for the same blocks during the 1985-1990 atlas.” From *The distribution and status of ruffed grouse in Indiana: 25 years of decline* by Steve Backs and John Castrale, wildlife biologists.



Ecological Subregions of Indiana

Similar to Homoya's Natural Regions used in the above analysis, this map identifies unique ecological regions in the State. It was decided to use Homoya's Natural Regions in the analysis because it offered increased opportunity for information overlap and project specific use in the State. The map below was created by the USFS.

